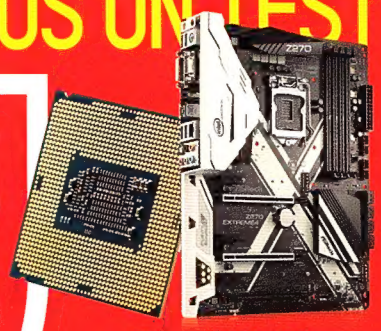
TEL 7TH-GEN CPUS + Z270 MOBOS ON TEST

a+pc

Jan 2017
Issue 437

YOUR EXPERT GUIDE TO TODAY'S TECH



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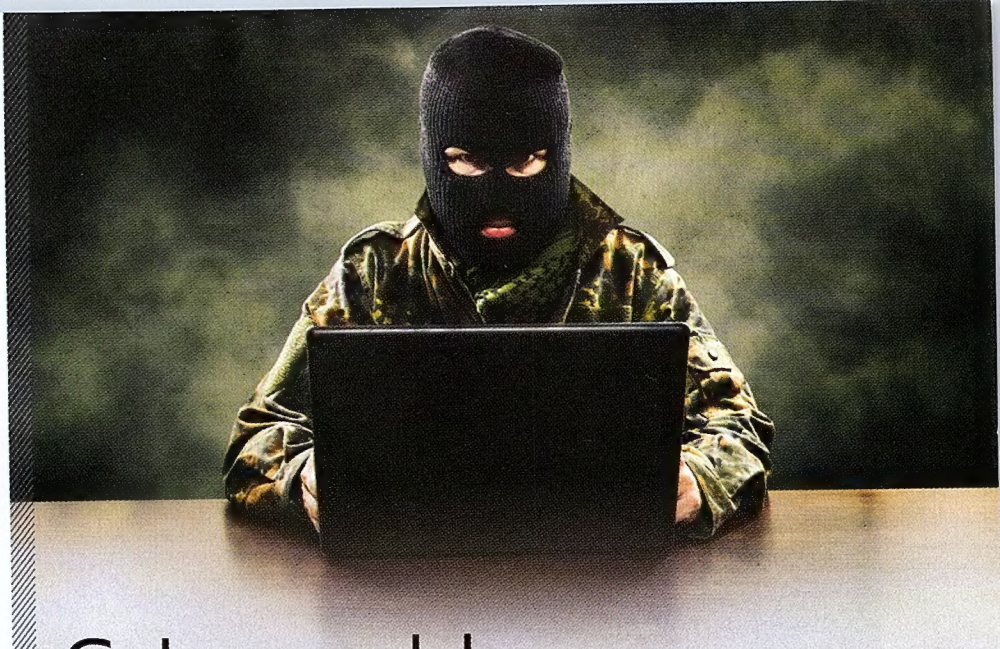

Cyber cold war gets hotter

Disinformation has always been an effective tactic in warfare, and 2016 just might have seen its most effective deployment yet. *APC*'s editor Dan Gardiner weighs in.

Given that we live in the information age, it shouldn't come as a huge surprise that – as Edward Snowden's NSA document leaks have shown – a cyber cold war has been rumbling along behind the scenes for as almost as long as the web's been around. And in the age of the cloud, where more and more personal, government and corporate data is stored online, the stakes have got even higher.

By all measures, 2016 represents a new escalation in that conflict. If US intelligence sources are correct, there was a concerted Russian campaign to destabilise the 2016 US presidential race and those efforts were tilted towards getting Donald Trump elected. Up until now, behind-the-scenes theft of information – like intelligence or corporate and state secrets – has formed the backbone of this cold war. But this last year has seen a new tactic employed in the online arena: disinformation or, as it's been dubbed, 'fake news'. By all indicators, its been exceptionally successful when it comes to sowing chaos in the West.

It's impossible to say exactly how much of an influence fake news stories had on the election, but there are some alarming figures around how much more vigorously fake stories are shared on social media.

Of course, not all fake news has been crafted to deliberately steer opinions – as with any disaster, there are plenty of opportunists who've just turned up to make a buck in the chaos. Many of the most popular sources of this disinformation are 'news' outlets that deliberately fabricate stories to get clicks, picking and mixing topics and targets to get people outraged enough to read the story.

The problem's garnered enough attention that it's galvanised tech giants like Twitter, Google and Facebook to do something about it – see Tech Brief on page 12.

Of course, the best vaccination against disinformation is, as it's always been, a healthy dose of incredulity. If you see a headline on Facebook that immediately causes outrage, chances are that it's been deliberately crafted to do just that (and it probably plays fast and loose when it comes to little things like 'facts'). So stay sceptical, check the credibility of the source and don't be afraid to call out bullshit when you see it. ■

DAN GARDINER
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Future

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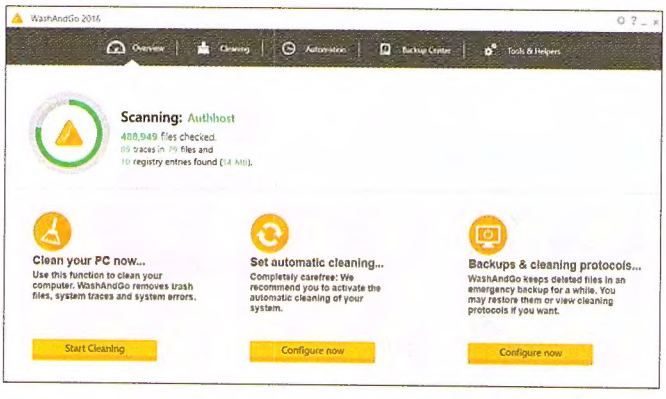
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» NEED TO KNOW

Racing pulse: Fitbit buys Pebble, but not its wearables

PIONEERING SMARTWATCH STARTUP TO SHUT DOWN

Fitbit has announced that it's only acquiring the indie smartwatch maker's intellectual property and key staff, dropping the hardware. Having released Fitbit Blaze, the health tracking giant requires Pebble's smartwatch platform to help it diversify. Pebble's Time 2, Core and Time Round Kickstarter Editions will not be going into production and backers who haven't received the product will be refunded. **SS**

Amazon implements new restrictions to limit fake reviews

SEEKS TO INCREASE TRUST ON RATINGS

Global online marketplace Amazon will restrict its users to posting five reviews per week on non-verified purchases (i.e. products not bought through the site). Customers can still rate as many products bought through Amazon as they like, though the policy does not extend to books, movies or music, which can be reviewed by anyone as much as they wish. **PT**

Between a block and a hard place

ADBLOCK PLUS WINS ANOTHER COURT CASE

Recently, Eyeo GmbH the company responsible for the AdBlock Plus extension has successfully defended itself against the sixth court case which has challenged its legality. With a recent survey by the Interactive Advertising Bureau showing 27% of Australians using some form of ad-blocking software, it's a potential win for consumers — but a blow for online publishers that survive off ad revenue. **HD**

VR bigwigs team up to form global association

Aim to create some universal VR standards.

Still in its infancy, many feel that the world of virtual reality is kind of like the Wild West right now. In an effort to implement some VR standards, a group of the biggest names in the industry have joined forces to create the Global Virtual Reality Association (GVRA) – a non-profit organisation that aims to "develop and share best practices for industry and foster dialogue between public and private stakeholders around the world", said the statement published on the association's website.

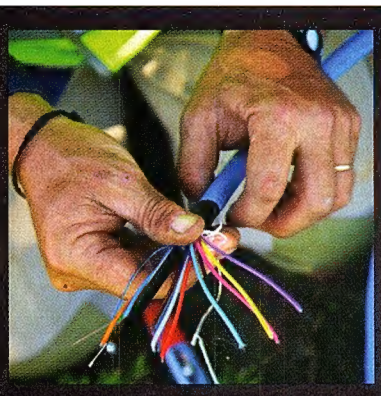
Backed by the likes of Acer Starbreeze, Google, HTC, Facebook, Samsung and Sony Interactive Entertainment, the association's goal is to "promote responsible development and adoption of VR globally" and to "develop and share best practices, conduct research, and bring the international VR community together as the technology progresses".

Rounding out its mission statement, it's promised that "the founding companies of the Global Virtual Reality Association will work to unlock and maximise VR's potential and ensure those gains are shared as broadly around the world as possible." **Stephen Lambrechts**

Are smart toys spying on your kids?

"DON'T ASK ME – I'M JUST A CORPORATE SPY!"

Most parents know the potential dangers involved when kids use a computer to go online, but how about when they play with their toys? The rise in popularity of internet-connected 'smart toys' poses a substantial threat to the privacy of young children, says The Center for Digital Democracy (CDD), which filed a complaint to the Federal Trade Association in Washington, DC. In its complaint, the CDD states that "by purpose and design, these toys record and collect the private conversations of young children without any limitations on collection, use, or disclosure of this personal information," suggesting an Orwellian-scenario where "the toys subject young children to ongoing surveillance and are deployed in homes across the United States without any meaningful data protection standards." The complaint specifically name-checks Genesis Toys, the toy manufacturer behind My Friend Cayla and I-Que, as well as Nuance Communications, which provides the toy maker with third-party voice recognition software. **Stephen Lambrechts**



Cash on commercial terms

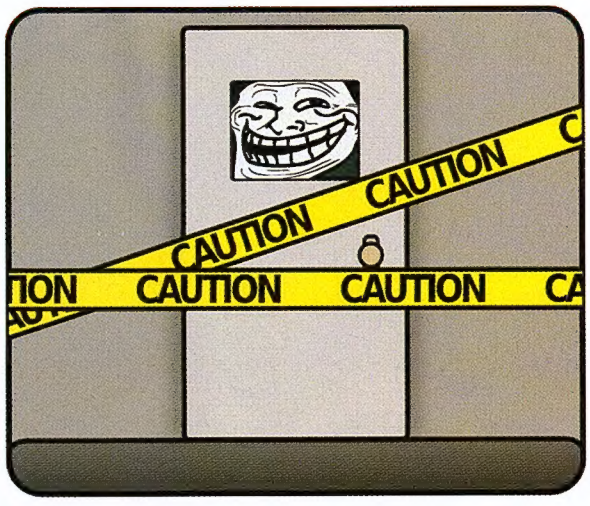
AU GOVT TO LOAN NBN CO $20B TO FINISH ROLLOUT

The Federal Government has rescued NBN Co by announcing it will loan the network builder $19.5 billion to complete the rollout of the National Broadband Network. It was revealed that the company would run out of funds in 2017, and this money would help it "fully focus" on the rest of the task. NBN Co had hoped to raise the money from the private sector, but the loan has been offered on "commercial terms". SS

Optus offering up free mobile data in exchange for watching ads

FREE DATA, BROUGHT TO YOU BY BOLLÉ SUNGLASSES

Are you willing to suffer through numerous mobile ads to get your hands on some free data? Optus has launched Optus Xtra, available now on the Google Play Store, that gives eligible prepaid customers up to 1GB of bonus data per month, or $2 worth of extra credit on daily plans every 28 days, so long as they're willing to let targeted ads be displayed on their Android phone's lock screen. SL



this subreddit has been banned

This subreddit has been banned for violating the reddit rules to keep everyone safe

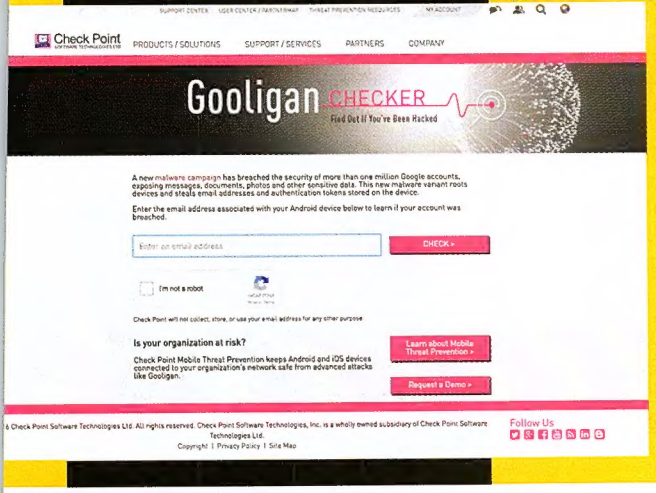
Reddit cracking down on abusive users (and CEOs)

Where's the line between censorship and moderation?

After a minor controversy involving its CEO took place on the pro-Trump subreddit **r/The_Donald**, Reddit has finally decided to make moves to curtail abuse on the popular social news site – and that means abuses of power from the company's higher-ups, but also abuse in general between its users.

CEO Steve Huffman (known on the service by his username Spez) used his privileges as a company engineer to modify – without trace – some nasty comments against himself to instead target the admins of the **r/The_Donald** subreddit. Within an hour, the comments were reverted, but not before cries of 'censorship' and 'abuse of power' rang out. Huffman has since apologised, claiming that the kind of secret editing power he had was being removed to ensure it wouldn't be abused again in future.

However, Reddit has also announced that it will now target especially "toxic" users from a site-wide perspective, rather than relying on moderators of individual subreddits and communities to tackle the problem themselves. This initiative will include warnings, timeouts or even permanent bans in an effort to keep the community open for free debate, but still civil and free of harassment. **Harry Domanski**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Millions of Google accounts hacked via dodgy Android apps

GOOGLE GOOLIGANS AND HOW TO SPOT THEM.

It's amazing the lengths some people will go to for an app rating. According to a report from security firm Check Point, over a million Google accounts have been hacked by malware dubbed 'Gooligan', which targets devices running Android versions from 4.1 to 5.1. It uses a rootkit in order to gain privileged access to a phone's OS, and its primary goal seems to have been to allow the attacker to leave bogus Play Store app ratings and reviews — and get paid while doing so. While Android Security and Check Point are working together on the issue, you can check if your Android device's Google account has been breached by visiting **gooligan.checkpoint.com**. You can also help prevent infection in the first place by avoiding any dodgy third-party Android app stores. **Harry Domanski**

technotes

» HARRY DOMANSKI LOOKS AT THE NUMBERS DRIVING THE BIG TECH NEWS

30%

POTENTIAL REDUCTION IN COST OF WIND POWER BY 2030.

A survey, conducted and summarised by online journal Nature Energy, has asked 163 of the world's "foremost wind experts" about the future cost of wind power, and it's apparently looking good. They suggest we could be seeing a reduction in prices of around 24–30% by 2030 and 35–41% by 2050. The survey takes into account floating offshore, fixed-bottom offshore and onshore wind strategies. Hopefully this kind of expert elicitation can be used to make better informed policy, as well as helping to steer research industries in the right direction.

Photo by José Fonseca (Flickr) / CC BY

90%

THE PERCENTAGE OF APPLE CHARGERS ON AMAZON FOUND TO BE FAKE.

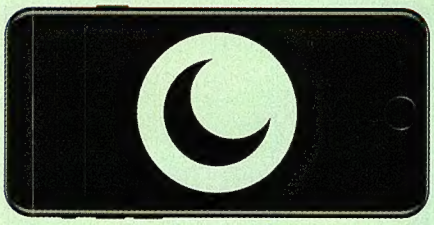
Knock-off Apple gear is everywhere, we all know that, but the extent of it is truly alarming. After testing over 100 chargers that claimed to be authentic, Apple itself found that around 90% of products bought on Amazon were fake. A lawsuit has been filed against Mobile Star LLC, which Apple believes is primarily responsible for providing Amazon with the knock-off chargers and cables. With the death of an Australian mother in 2014 being caused by a fake charger, it's probably worth investing in the real deal.

SFMTA
Municipal Transportation Agency

US$73,000

THE AMOUNT DEMANDED IN RANSOMWARE ATTACK ON A SAN FRANCISCO TRANSPORT SYSTEM.

In a Black Friday cyber attack, San Francisco's Municipal Transportation Agency was given the choice of either coughing up US$73,000 or sitting tight while their systems sat even tighter. The ransomware disabled staff terminals and ticketing for both trains and buses, resulting in a lot of free rides. The systems were back up by the Sunday, although as it's an ongoing investigation, it's currently unclear if they ended up paying the ransom, or rescuing the system themselves.



70%

THE NUMBER OF AUSSIES THAT KEEP THEIR PHONES CLOSE WHILE THEY SLEEP.

After conducting a global sleep census with more than 11,000 participants — including 2,300 Australians — mattress-maker Sealy Posturepedic thinks we need a tech detox, as 70% of Aussies can't sleep too far from their mobiles. The findings suggest a "strong association between high levels of insomnia and the nation's addiction to technology in the bedroom". Among its solutions, Sealy suggests making the bedroom a "screen-free zone", as well as establishing a regular bedtime... and of course, sleeping on a preferably-pricey mattress that provides full support.

US$20K

THE AMOUNT NINTENDO IS OFFERING FOR 3DS EXPLOITS.

Nintendo has placed a bounty on the heads of any exploits found on its flagship 3DS portable gaming unit, with rewards ranging from US$100–20,000 depending on the importance and quality of the information provided. Working through bug bounty platform HackerOne, Nintendo is hoping to source vulnerability information on piracy, cheating and dissemination of inappropriate content to children, with the goal of maintaining the 3DS's "secure environment". Does this incentive mean that hackers now have a legitimate ethical decision to make?

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tech brief

» CARMEL SEALEY WADES INTO A CURRENT NEWS TOPIC TO TAKE A CLOSER LOOK

Fake news and the fight for the truth

APC issue 438 will soon be available on papyrus.

Unless you've been living under a log these past few months (or have put a blanket ban on all news as a result of the US elections – and we don't blame you), you will be aware of the attention 'fake news' has been getting recently. And with headlines such as 'Michelle Obama Picks A Fight With Melania Trump, Learns Instantly That Was A Huge Mistake' (as spoken about in the Christmas issue of *APC*, page 19), you can see how people with certain political leanings could be influenced by these stories. Fake news items can be very damaging, especially when their 'fake' or 'satire' status isn't displayed clearly, and in today's age when an increasing number of people rely on social media as a major news source, it's scarily easy how quick these misleading stories can spread. In this month's News Dive, we're going to look at the effects and also the fight to expose the spread of news disinformation.

Social medias strike back at fake news

UNLIKE. UNLIKE. UNLIKE!

While many believe that social media sites are greatly to blame for the spread of fake news, both Facebook and Google have recently taken swipes at the misleading 'news' sites themselves. Advertising and search engine giant Google has said that it would prevent such sites from using its own online advertising service. Facebook then jumped on the bandwagon (despite CEO Mark Zuckerberg having denied the site was at fault) and said that the company had updated its Audience Network policy wording to say that it would not allow its ads to be displayed on fake news sites. Baby steps...

Why fake news appeals

CONFIRMATION BIAS AND THE FILTER BUBBLE STRIKE BACK.

People who frequent social networks are often caught in a 'filter bubble' — the phenomenon where stories relating to ones you and your friends have liked are shown more often and given priority over others. This creates a dangerous environment for 'confirmation bias', where your views are not moderated by alternative views, merely confirmed over and over again, regardless of the facts. Mix that in with some good old-fashioned laziness on the part of the reader to find out whether the news source is credible and you have the perfect breeding ground for fake news.

Pope weighs in on fake news

POPE FRANCIS: THE SPREADING OF FAKE NEWS IS "THE GREATEST DAMAGE THAT THE MEDIA CAN DO".

As demonstrated perfectly in the movie *Wag the Dog*, the media is a tool that some can manipulate to their own ends and many believe without question. Pope Francis declared that "the media have to be very clear, very transparent" and that they should desist from "wanting to cover scandals [and] nasty things, even if they are true". In that case, um... maybe we shouldn't print that article I wrote about the rash on my calf...

People usually can't remember news on Facebook, real or not

LIKE, I READ THIS ARTICLE THAT TOTALLY SAID, LIKE... UM... YEAH.

While the media is getting its knickers in a twist about how many times fake news stories were shared online during the US elections, a study commissioned by BuzzFeed has led to an interesting, well, twist. 3,015 US citizens participated in the survey in which they were shown six headlines (three 'fake news', three real) and asked if they remembered seeing them. If they did, they were then asked to gauge the article's truthfulness. Interestingly, a mere 20% of those surveyed remembered the headlines at all. The study also concluded that the participants recalled the real news stories and believed them more readily than they did the fake ones. Yay?

Not all fake news has a malicious motive

SOME STORIES ARE CREATED TO HIGHLIGHT THE PROBLEM.

A team from NPR tried to track down the author of the fake news story 'FBI Agent Suspected In Hillary Email Leaks Found Dead In Apparent Murder-Suicide'. After a lot of digging, they found the man who ran the host site. Coler has been writing 'fake news' since 2013 with the aim of infiltrating "the echo chambers of the alt-right", publishing fake news items which he could then "publicly denounce" in an effort to highlight just how easy it was to spread misinformation online. Coler also revealed that "rabid Trump supporters" were the easiest to fool. ■

About iFixit

iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their own products. To learn more, visit **www.ifixit.com**.

Google Home

No hidden anomalies here, no sir.

A simple ribbon cable holds the swappable outer shell in place.

Google wants to bring the robot assistants of the future to the world today. Equipped with Google Assistant, the Google Home is raring to work with smarthome devices, support Google services and answer questions. Does it have what it takes to fulfill your futuristic fantasies? Time to tear down the Home!

MAJOR TECH SPECS

- High-excursion speaker with two-inch driver and dual two-inch passive radiators
- Far-field microphones
- Customisable base
- 802.11ac (2.4GHz/5GHz) Wi-Fi
- Touch surface controls

KEY FINDINGS

- Removing the base gives us our first look at that high-excursion speaker and a hidden micro-USB programing/debug port. To pull out the four Torx screws hiding deep in the speaker recess, we grab our fixed-blade screwdrivers for a little extra reach. Once they're out, we pop the top. The lid separates with ease, and finally, the capsule is open.
- After sending out a few test signals, we move on to disconnect a pesky interconnect cable. This runs from the motherboard up to a board tucked in the top of the lid, probably home to a fancy microphone and LED array.
- There's some seriously strong adhesive holding this board to the upper case. With a final yank (and a big dose of isopropyl alcohol to dissolve the glue), the LED board comes free to reveal the source of our struggle: a ton of adhesive tape.
- The stretchy O-ring seems to be the key to delving even deeper inside this smart speaker. In addition to its role as a gatekeeper, the O-ring probably also functions as a vibration dampener. This seems a more repair-friendly solution than the layer of stuck-down fabric on the Amazon Echo.
- The bit that holds the magnets for the bottom case also has a mystery cable locked inside it. Closer inspection reveals: yet more mystery! The cable sports four contact points. Perhaps more testing points? Alternate (made-up) theories: Recognises the base colour, so the Home can co-ordinate its outfits better; vestigial charging mechanism (maybe the Home's architects intended it to be portable); abandoned Easter egg dungeon level for teardown engineers.
- **Repairability score:** 8 out of 10 (10 is easiest to repair). Minimal moving parts mean there are minimal points of failure. Only standard screws and connectors are used throughout the device. Many components are modular and can be replaced individually. The DC-in port is soldered to the motherboard, but is unlikely to experience much wear, considering the device stays plugged in. The touch board is strongly adhered to the upper case. ■

technotes

» GEAR WE WANT

BIXI

BIXI.IO | FROM US$79 + SHIPPING

Touchscreens are fantastic, but if you're following a pizza recipe on the iPad, do you really want it covered in flour? (The iPad, not the pizza.) Sometimes, what you need is gesture control! Bixi, recently successfully crowdfunded on Kickstarter, is a gesture-tracking device for controlling your iPad, iPhone and smart devices (even a GoPro). Swipe your hand down over the device to scroll down a web page; raise your hand to turn up the volume, for example. The company also suggests using it in the car, so you're less distracted. The idea is great, although how it works in practice will be interesting.

LEICA TL

LEICA.COM | $2,450 (PREORDER)

Leica's high-end cameras offer a brilliant mix of old-school style with modern features. This latest model is even more innovative and reliable. New features include the doubling of the internal buffer memory to 32GB, improved autofocus (particularly in AF-C mode) and optimised compatibility with lenses from other camera systems in the Leica range. There's also a new Leica TL app that offers additional options for transferring pictures wirelessly, or sharing them on social networks.

BLUESMART ONE

BLUESMART.COM | FROM US$449 (+ SHIPPING)

This suitcase also started as a crowdfunding project that, back in 2014, achieved a staggering 2,730% funding goal. Possibly the smartest suitcase currently available, the Bluesmart One includes its own digital scales to weigh all your stuff before you leave home. It also uses Bluetooth, 3G and GPS technologies to prevent theft and help you locate the case pretty much anywhere in the world. Not to mention that it also charges your devices.

technotes

» EPINIONS

TEACHING AN OLD DOG NEW TRICKS

I've just finished refreshing my old Samsung laptop. Over the past few years I've read various articles you've written regarding upgrading, so I decided to give it a try. I now have a very speedy laptop with much better battery life and it cost me AU$130.

The computer is a Samsung NP-305v5a-S06AU laptop powered by an AMD A8-3510MX CPU, Radeon HD 6620G GPU, 8GB RAM, 750GB 5400RPM HDD and 4,500mAh battery.

The memory is good, as is the CPU – besides I don't think I can upgrade beyond what the factory installed. The battery was giving around 1–1.4 hours max on full charge and the Windows 7 performance assessment was that the HDD was holding it back badly.

I went on eBay and upgraded to a new after market 7,800mAh battery and a 240GB SSD.

The upshot is that I now have a very snappy laptop that gives me around three to four hours on full charge and boots in seconds instead of minutes.

I didn't bother with trying to move data from my 750GB drive; just performed a fresh install, which also helped the process.

> "The upshot is that I now have a very snappy laptop that gives me three to four hours on full charge and boots in seconds instead of minutes."

I created a separate 30GB partition and installed Remix OS to see whether or not this Android port was any good. I have a Lenovo Android tablet which seems to have been subsumed by may wife, so I was looking for an Android device for those moments (increasingly more frequent) when the Lenovo was not available.

If anyone is interested in Remix OS you can download it from **www.jide.com/remixos** for free. If you have an AMD-based PC like mine, or an older Intel machine, you'll probably need to install the 32-bit version. It attaches a menu item on the Windows boot menu so you can either boot into Windows or Remix OS. So far, most of the apps I've tried have loaded and run fine. Two notable exceptions are both of the Android Opera web browsers, but Chrome and Firefox work fine as does BlueMail and Microsoft Word and Excel (however, these only work in read-only mode unless you buy an Annual Subscription). Other free Office software seems to work just fine. AVG free is installed and running well.

Just thought I'd let you know that you're never too old to try something new. I'm 65 years old and have never tried to upgrade a laptop before, for fear of doing irreparable damage.

Ian Hollis

APCMAG@FUTURENET.COM

Come on, have your say!

We want to hear what you think. Add to these discussions or email your views (in fewer than 250 words) to **apcmag@futurenet.com**. All correspondence becomes the property of *APC* and is subject to editing. Letters must include full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

Facebook colludes in state censorship

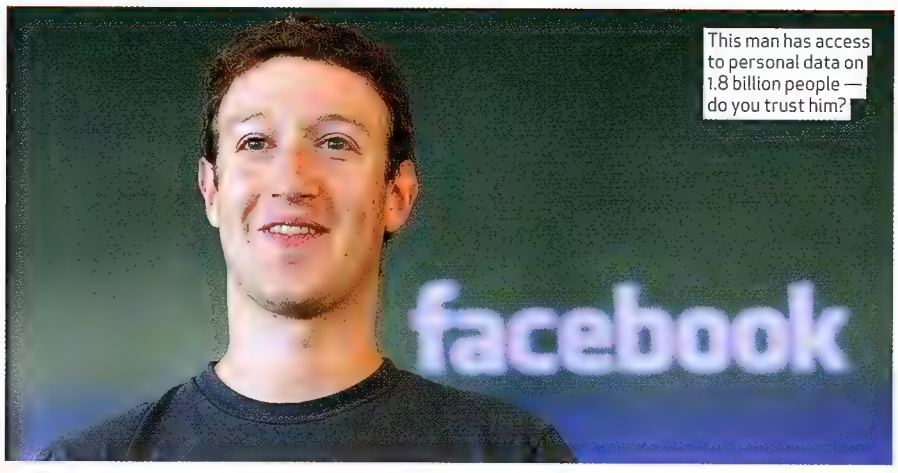
Just how far will the social media company go to break into new markets?

Facebook is preparing for the Chinese market, and part of that preparation is the development of tools to enable the Chinese Government to suppress unrest by ensuring that posts on certain subjects never appear. Facebook won't do the censorship itself, but it will supply the means for a third party to monitor feeds and decide what goes live.

Facebook has refused to confirm or deny the existence of such tools as yet; it's still an internal project. Their existence was leaked by employees, alarmed by the implications. The Electronic Frontier Foundation, the leading non-profit organisation defending civil liberties, calls the project "extremely disturbing".

Facebook has made no secret of trying to get into China. CEO Mark Zuckerberg has made many visits, met President Xi, and even started to learn Mandarin. The lure is obvious. The internet is censored in China, and effectively, too. Any company that doesn't comply faces being blocked; censorship isn't optional. Actually, such tools were inevitable.

China loves the internet, censored or not. Realistically, though, Facebook's chances of success there are pretty slim. A domestic Facebook-like app has already failed there. Renren claimed 160 million users at its stock launch, but quickly withered. The big thing is WeChat, largely used on smartphones; it has 846 million active users. Blocking foreign competition for so long has enabled domestic companies to become well established. Put simply, the Chinese state would prefer the big players on its home turf to be Chinese and under close control, and it has the power to make that so. Apple is a rare success, and that has drawn a backlash.



This man has access to personal data on 1.8 billion people — do you trust him?

Meanwhile, at home, Facebook has faced calls to censor fake news stories, many of which circulated before the election, at one point gaining more coverage than the real ones. Initially, the company denied it had influenced the outcome of the election — "a pretty crazy idea", according to Zuckerberg. He may have a point. People tend to read and spread stories they already either agree or disagree with strongly. This was later followed by a more nuanced response. Facebook said it will employ third-party fact checkers and stronger detection by algorithms in future.

We may abhor censorship in theory, but it's remarkable how quickly it is called for when we don't like the results of unrestricted access. It is a slippery slope on a delicate balance. As Zuckerberg commented, "We need to be careful not to discourage sharing of opinions or mistakenly restricting accurate content." However, it is still a big step from removing individual articles to allowing wholesale censorship on specific subjects under state control. The Chinese experiment is moving into darker waters.

An uncomfortable question here is: how far is Facebook willing to compromise to get new business? Social media sites need to keep moving or they sink. Facebook has started to hit the limits on growth in mature markets; with 62.5% of adult Australians having access (and an even higher 67% in America), there can't be much more room for growth. To grow, it must go abroad, where local laws and state controls can be very different.

In a recent press interview, Mark Zuckerberg was asked what checks and balances needed to exist for entities such as Facebook. The reply consisted largely of platitudes on connectivity and the power to share. It was particularly unconvincing stuff. There is a growing gap between accountability and responsibility that will definitely need addressing at some point. ■ **Chris Lloyd**

END USER

Share your stories!

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2017 TECH PREVIEW

The last 12 months saw incredible steps forward for our beloved PCs, but what's on the horizon? Where are things going next? We sort through the rumours and lies to discover what is really lined up for the next year, when new kit should arrive, and where it's going to take us.

The APC team

A NEW HOPE

AMD's new Zen CPU takes aim at the Intel empire.

Not to put too fine a point it, but expectations are nothing if not high for AMD's upcoming Zen CPU architecture. We've previously branded it as being everything from a new hope to AMD's absolute last chance for survival. And as we look forward to 2017, the year that the Zen will finally arrive, it feels every bit as portentous as all that – Zen is a really big deal.

That's chiefly because competition improves the breed, and ever since AMD launched its failed Bulldozer architecture back in 2011, Intel hasn't really had any competition in the PC processor market. The consequence of that has been a state of general stagnation in terms of mainstream CPU performance on the desktop. Intel's processors have been quad-core items, and have only improved very marginally in terms of conventional CPU performance over the past five years.

It's into that context that we're hoping AMD can drop a big old bomb with Zen. The good news is that there's every reason to be optimistic. For starters, AMD has been fairly open about the errors of Bulldozer's ways. So, say goodbye to Bulldozer's radical modular architecture. Zen switches back to heavy-duty CPU cores, each with a full set of their own resources for crunching through as many instructions per clock cycle as possible. Zen also packs simultaneous multithreading, which means each core can process two threads in parallel. Sound familiar? It's just like a modern Intel chip.

AMD's aim with Zen is to increase the number of instructions the architecture can process per clock cycle – otherwise known as IPC – by 40% over existing AMD cores, without increasing power consumption per cycle. Sounds good, but will Zen deliver? AMD has demonstrated an eight-core Zen chip beating a same-clocked eight-core Intel chip by a small margin, albeit in a single benchmark. Also, the brain behind Zen happens to be Jim Keller. The same man who gave us AMD's killer Hammer architecture back in 2003. Then again, more recent rumours have suggested an eight-core Zen will offer performance more in line with a six-core Intel processor.

Anyway, it's thought that AMD will start with just one Zen CPU die for desktops, an eight-core design called Summit Ridge. If AMD really does inject an eight-core chip into roughly the same space as Intel currently operates with quad-core chips, that really will be a revolution.

Watch this space.

Remember when AMD had properly competitive CPUs?

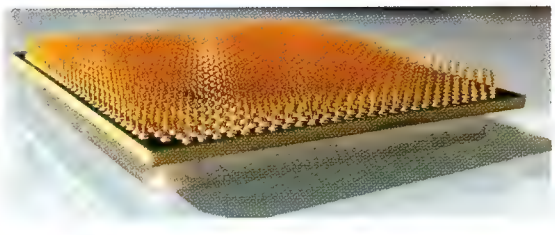
A PLATFORM FOR SUCCESS

If AMD's CPUs are looking crusty, its platforms and chipsets could also do with being taken out with the trash. Native support for modern high-bandwidth interconnects and storage are conspicuous by their absence. Put another way, even if AMD's new Zen CPU architecture delivers on its promise, that will only be half the job done. AMD needs some new platforms, too. A warm welcome, therefore, for AM4, AMD's new socket, and the X370, B350 and A320 chipsets.

AM4 will also come with support for DDR4 system memory. But it's elsewhere that the real interest lies. The new platforms seem to have all the bases covered: nothing is official as we go to press, but NVMe and M.2 storage, plus native USB 3.1 Gen 2 and PCI Express 3.0 are all reportedly in the mix, according to leaked documents.

The top chipset is the X370. That will pack dual x16 PCI Express 3.0 ports for multi-GPU action. X370 will also have a full range of overclocking features. Beyond that, not a great deal is known. We certainly hope that additional PCI Express 3.0 lanes will be available to allow dual graphics, plus a high-speed PCIe SSD.

There's reason to think that, as leaked details about the mid-range B350 chipset indicate it will come with support for two PCIe drives, although the actual number of lanes available to each drive isn't clear. All told, it looks promising, and exactly what AMD needs to complete its next-gen offering. All the indications are that Zen and its supporting platforms will be announced very early in 2017, so here's hoping Intel finally has a fight on its hands.



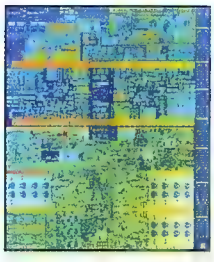
INTEL'S CONFUSING NEW CPUS

A six-core mainstream Intel CPU at last?

Tick-Tock is dead. Long live Process, Architecture, Optimization. It's no secret that the whole chip industry is now having trouble keeping up with Moore's Law, hence Intel dropping its Tick-Tock cadence, and with it, a commitment to die-shrink its CPUs every other year.

However, what is a little surprising are rumours involving yet another 14nm CPU architecture to follow the freshly-minted Kaby Lake. The first 14nm family was, of course, Broadwell, which begat Skylake, which was, in turn, usurped by the aforementioned Kaby Lake. But the latest leaked CPU road maps from Intel indicate a hitherto unknown family of chips called Coffee Lake.

Looks as though Kaby Lake won't be Intel's last 14nm design.



Nothing is certain, but the indications are that Coffee Lake will be 14nm. That's a surprise in itself, but the really intriguing development is the addition of a six-core Coffee Lake model for mainstream sockets. If true, it will be the first six-core mainstream chip from Intel for desktop PCs. The six-core chip will also find its way into laptop PCs.

We can't help noting that the emergence of Coffee Lake coincides with AMD nearing launch with its Zen architecture. Already, it seems, Zen is influencing the CPU market for the better. A mainstream six-core CPU from Intel is long, long overdue, and almost certainly hasn't happened before because AMD hasn't put Intel under any pressure for the past five years or so.

Coffee Lake is due in 2018, so a little after Intel's first 10nm chips, known as Cannon Lake, and penciled in for late 2017, albeit only for mobile PCs. One major change with Cannon Lake is embedding the PCH chip in the CPU die, making Cannon Lake more or less a full-fledged SoC, or System-on-a-Chip.

That will be very interesting from a mobile PC perspective, in terms of power consumption and packaging. It should enable some fairly exotic designs in terms of compactness, and squeezing true desktop performance into smaller designs than ever before.

Beyond that, relatively little is known about Cannon Lake, or indeed its 10nm successor, Ice Lake. Talk of eight-core Cannon Lake chips has circulated, but at this stage, that is highly speculative. Given that Cannon Lake is ostensibly just a die shrink of Kaby Lake, it's perhaps Ice Lake that you might expect to bring major architectural innovations. But given the flux Intel's road maps have suffered of late, we wouldn't rule anything out over the next year or three.

INTEL'S NEXT-GEN SUPER-CHIPS

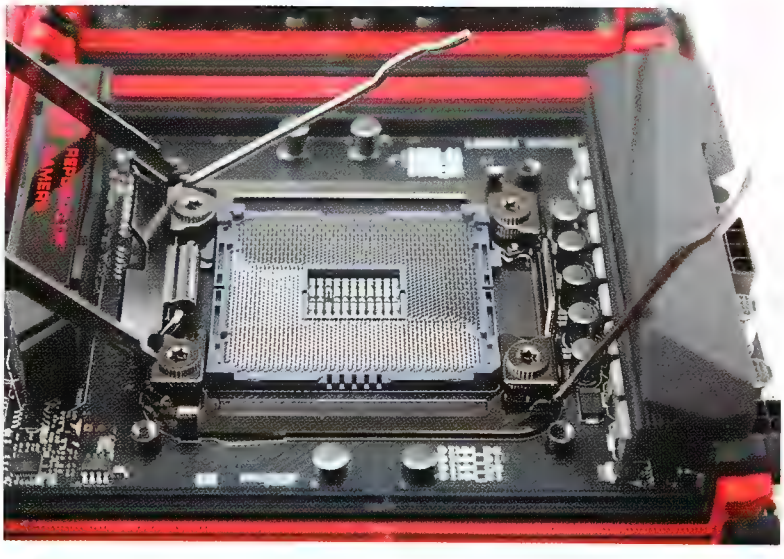
Intel's Kaby Lake chips are now shipping in both mobile and desktop form, which means Intel's high-end platform finds itself in the odd position of being fully two generations behind in architectural terms. Currently, the Core i7 Extreme Edition lineup, including the monstrous 10-core i7-6950X, is based on the Broadwell-E architecture.

With that in mind, it makes a certain kind of sense to find that Intel is preparing a double whammy for its high-end desktop series in 2017. It seems both Skylake-X and Kaby Lake-X chips are go for launch.

Skylake-X will be the bad boys of Intel's 2017 range, rocking in with six, eight or 10 cores, and TDPs up to 140 watts. Sky Lake-X chips will also pack as many as 44 PCI Express 3.0 lanes for massive I/O capability, along with a quad-channel memory controller. That said, Intel already offers a 10-core CPU, so it remains to be seen whether Sky Lake-X will be much of a step forward for raw performance.

Kaby Lake-X, meanwhile, will be limited to a mere four cores, 16 PCI Express lanes and a dual-channel memory controller. If that seems like a retrograde step, our best guess is that the Kaby Lake SKUs may be a pre-emptive response to AMD's new Zen CPUs. AMD will be offering a full range of traditional Zen CPUs without integrated graphics, and Kaby Lake-X could be an attempt to see off the bottom end of the Zen offering. Whatever, both of these new CPU families from Intel will slot into the new LGA2066 socket, breaking backward compatibility with existing LGA2011 platforms and chipsets. Consequently, a new platform and chipset, codenamed Basin Falls-X, will arrive. Highlights will include up to 10 USB 3.0 ports and up to 24 lanes for PCI Express storage.

Not long for this world: Intel's LGA2011 socket.



TEAM RED PIXEL PUNCHERS

Where have we been and where are we headed?

2016 has been a year of graphical revolution. We finally transcended the confines of 28nm down to 16nm and 14nm. Big wins have been made for both Team Red and Team Green, as performance-per-watt figures spiked in celebration of this new transistor size. But it hasn't been a bed of roses for the guys at AMD. With an early entry into the mid-range battlefield, AMD clawed market share back from its green rival, but seven months on from the launch of the price-to-performance dominator that was Polaris and the RX 480, we've still seen nothing in regard to a true endgame from AMD. Nvidia is left to reap the rewards, dominating the field with the GeForce GTX 1080 and 1070, able to price itself wherever it pleases. So where are we heading?

The answer is Vega. A plethora of rumours surround the card, but all we know for sure is that it will be debuting in the first quarter of 2017. With it likely to be revealed at CES, by the time you read this, it should have been announced.

At a guess, we expect this new GPU architecture to still be based on GlobalFoundries' 14nm FinFET manufacturing process, featuring twice as many compute units and shader cores as the RX 470 – around 4,096 cores in total. In terms of memory, it's a widely held belief that these cards should come packing HBM 2.0, and the delay is due to AMD trying to work the bugs out of the manufacturing process. With 16GB of HBM 2.0 being the top end, we can expect somewhere around 512Gb/s total memory bandwidth.

Alongside Vega 10, we're expecting a cutdown variant of the new architecture, known as Vega 11. This should be the spiritual successor to the RX 480 and the original Polaris chips. Based on the same architecture as Vega 10, we expect it to come with around 30% fewer shaders and compute cores, and perhaps even a drop down into HBM 1.0 and GDDR5 memory, hopefully with a TDP of less than 75W on the lowest end of that spectrum.

This will likely be followed by a rebadging of the Polaris architecture at the bottom end. It's hard to say what the nomenclature will be, but our money's on AMD dropping the RX 400 series and opting for the RX 500 series instead.

BEYOND THE BEYOND

With AMD and Nvidia announcing their product timelines publicly, we can comment on a few items that we know for certain are coming over the next few years. We know that Vega 10 and 11 should be dropping in 2017, to be followed by AMD's transistor shrink in 2018 from 14nm to 7nm, thanks to the help of GlobalFoundries. This means we could expect to see a dual-cored, 7nm card in only two years. Vega 20 (all hypothetical from this point onward) should come packing a phenomenal 32GB of HBM 2.0 for a mind-boggling 1TB/s of total memory bandwidth, and a scarily huge 8,192 shader cores. That's around nine times more transistors than found in a single RX 470 – 45.6 billion on a single GPU.

Vega 20 sounds insane and, for now, is just rumour. But when you consider that alignment with GloFo's 2018 goals, and the fact that AMD will launch its new Navi architecture in 2019, it's a lot more reasonable to expect Team Red to produce a 7nm dual-cored test subject, before dropping a new architecture on top of a die shrink simultaneously.

Soon, Polaris 10 will be replaced by the far superior Vega 11 architecture.

THE MEMORY CONUNDRUM

After last year's bonanza, with GDDR5X and HBM making it to market, and DDR4 cementing itself into Z170/B150 chipsets, little looks likely to change for memory. DDR4 will still hold true in the mainstream platforms, with AMD's Summit Ridge and Kaby Lake supporting it. While, no doubt, frequencies will continue to rise, alongside a drop in the cost per Gigabyte, there'll be little in the way of revolutionary change. Quad-channel will still be limited to HEDT variants, as Skylake-X retains the mammoth bandwidth standard, with Kaby Lake-X holding on to the dual-channel heritage.

HBM 2.0, on the other hand, is a real game-changer. Over the last year, we've seen game developers take ever greater advantage of larger frame buffers and faster memory bandwidth, and with GDDR5 taking a backseat in terms of PCB space consumed versus memory transfer speeds, HBM filled that gap. Unfortunately, HBM 1.0 is still a flawed standard, only capable of supporting up to 4GB of VRAM at 512GB/s total bandwidth (each stack supporting 128GB/s). HBM 2.0 looks to remedy that situation, enabling 4GB of VRAM at 256GB/s per stack, allowing for a total of 16GB at a combined memory bandwidth of 1,024GB/s.

LIFE AFTER PASCAL

Building on a winning formula.

Nvidia had a phenomenal 2016, thanks mainly to it being able to sort out its 16nm production process, and put it to good use with its Pascal architecture. Star of the show was, and still is, the GTX 1080, although for those with a more reserved eye on their bank balances, the likes of the GTX 1070 and 1060 have possibly had more sway in actual upgrades. Meanwhile, at the top end, the new take on the Titan X won plenty of plaudits, if you could afford premium pixel pumpers and could actually find a reseller with stock.

Fast-forward to 2017, and we should see the last logical addition to the family, the GTX 1080 Ti, make an appearance. It's rumoured to sit between the Titan X and the GTX 1080, with a specification and price to match. The reason that it hasn't been released sooner than this? There hasn't been a need for it – AMD doesn't have a competing card at the high end to take on the GTX 1080, which means Nvidia has been able to employ a 'wait and see' approach to proceedings. We will probably see the 1080 Ti as a response to an R9 490X. Expect 10GB of GDDR5X on the GeForce GTX 1080 Ti, 60 streaming multiprocessors and a sub-$1,000 price tag.

The next major GPU architecture from Nvidia goes by the codename Volta, and we could see the first GPU based on Volta as soon as May – it's expected to appear at the Graphics Technology Conference. Volta was originally planned for release in 2018 using the 10nm FinFET production process, but given the pains Nvidia and TSMC have had shifting to 16nm, it's no surprise that the transition has been delayed. So Volta will use the same 16nm process as Pascal, but benefit from a few tweaks in a move that is reminiscent of Intel's Tick-Tock updating regime.

Details are scarce, but we know Volta will support stacked RAM, aka HBM 2.0 (see 'The Memory Conundrum' opposite). The expectation is that Volta will do much better when it comes to asynchronous compute, too, as used by DirectX 12 and Vulkan. Despite the fact that Pascal has been warmly welcomed commercially and critically, AMD still has the edge when it comes to some DX12 code paths.

Volta will most likely appear in May, replacing Tesla P100 for supercomputers.

WHERE NEXT FOR VR?

While the HTC Vive and Oculus Rift work fairly well, the price barrier is enough to prevent either from really taking off – we're not just talking about the headsets, as you need a powerful graphics subsystem to drive a pair of HD displays at 90Hz, too. Indeed, a recent sales report puts both headsets as being minor in the overall VR market, with Google Cardboard leading the pack, and Sony's PlayStation VR already making interesting inroads.

Even so, as many have predicted, the big challenge for VR is on the software side – creating a believable VR experience can be incredibly expensive, and even the most impressive titles so far have been either very limited in scope or very short-lived. We still think there's plenty of room for more non-gaming experiences, too, but without a sufficient installed user base, we can't see radically new experiences emerging any time soon. It may be Sony's offering that starts the ball rolling here, but we'll have to wait and see where this is going.

What we do expect in 2017, though, is an influx of new VR headsets, something that will be partly driven by Microsoft's bullish entry into the market. Microsoft's interest in VR headsets for Windows 10 may well be a stepping stone to its HoloLens technology, but with the weight of the hardware industry behind it, renewed competition can only help. Headsets are expected from HP, Lenovo, Dell, Acer and ASUS, with suggested retail pricing starting at US$299 (about AU$400, minus the Australia tax). In fact, that pricing alone may be all that's needed to get VR into more homes, and then surely the titles should start rolling in.

INTEL'S AWESOME SSD TECH

Will Optane drives finally arrive in 2017?

There's a performance bomb heading for the solid-state storage market. That's what we said this time last year. But it never happened. Not as we hoped, at least. To put it another way, Intel and Micron's 3D XPoint memory technology, known as Optane when applied to Intel SSDs, never materialised.

Of course, 3D XPoint is a radical new type of memory tech, not an incremental improvement, so it's not exactly shocking that it's taking longer to hit the market than expected. But before we consider whether it will finally appear in 2017, it's worth recapping why it's so exciting.

3D XPoint is a non-volatile memory tech that's claimed to be up to 1,000 times faster, 1,000 times more robust and 10 times denser than the conventional NAND flash found in existing SSDs. Staggering stuff, but how does it work?

Unlike NAND flash, which is composed of memory cells consisting of gates in which electrons are trapped, 3D XPoint uses electrical resistance to store data. Each cell stores its bit of data via a subtle change in the conductive resistance of the cell material. A benefit is that this doesn't require a transistor, and that means each cell can be smaller, so more can be packed into a given area of memory chip. That means higher densities and more storage.

The other major difference is the fact that 3D XPoint's memory cells are addressable at the individual bit level. That's a dramatic change from NAND, where whole blocks of memory, usually 16KB, must be programmed to save just one bit of data. The consequences for NAND flash are time-consuming read-modify-write cycles, and the need for complex garbage collection algorithms. That's all gone with 3D XPoint, which should mean massively improved random access and IOPs performance.

Of course, much of that is theoretical. Early demos have shown random-access performance around five times faster than a current top SSD. Not quite 1,000. But imagine if Intel launched a CPU that was five times faster. Quite.

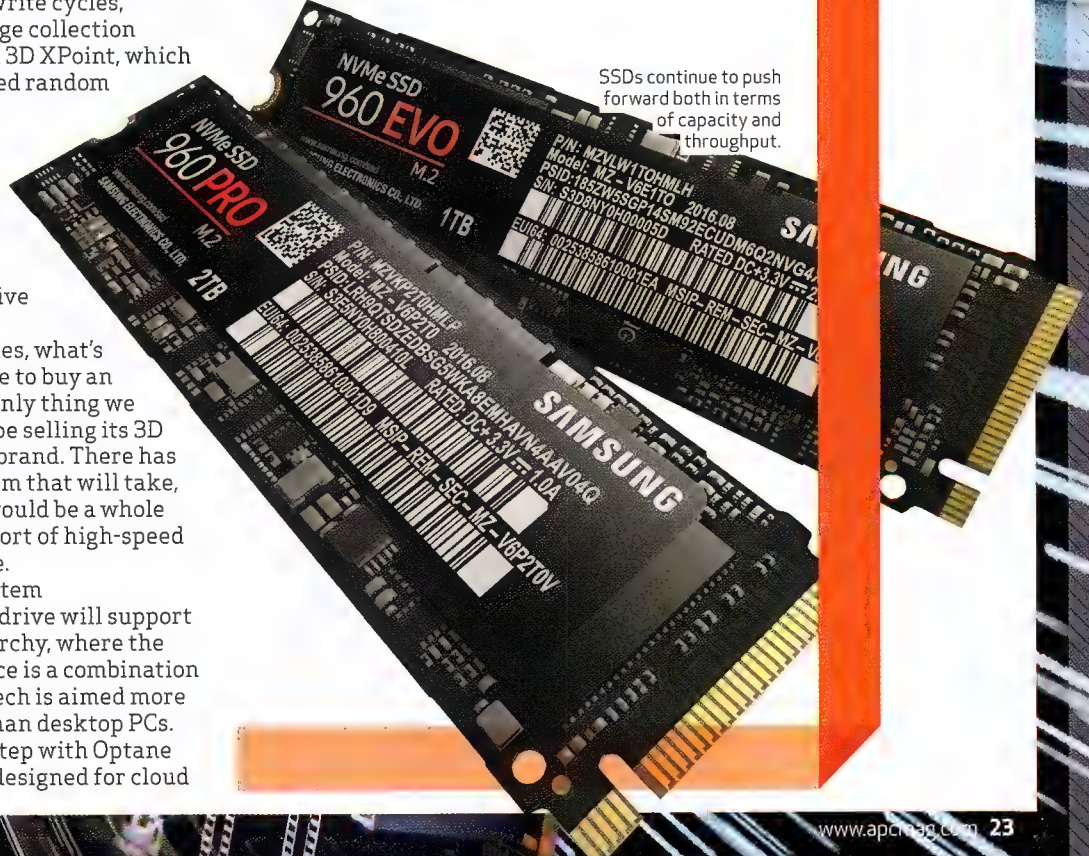
If that covers the technicalities, what's the latest on any of us being able to buy an SSD with 3D XPoint tech? The only thing we know for sure is that Intel will be selling its 3D XPoint SSDs under the Optane brand. There has been some debate over what form that will take, including implications that it would be a whole new memory class, acting as a sort of high-speed cache, rather than mass storage.

More specifically, certain system configurations with an Optane drive will support a software-defined cache hierarchy, where the CPU's addressable memory space is a combination of RAM and the SSD. But that tech is aimed more at heavy-duty database work than desktop PCs. With that in mind, Intel's first step with Optane will be Optane-based testbeds designed for cloud computing. Intel is partnering with Facebook to test the technology, and it's possible the latter is already using Optane to some extent.

However, the good news is that it's probably conventional Optane SSDs that will hit the market first. That's because using 3D XPoint as a system cache requires the creation and fine-tuning of a new software abstraction layer. Optane SSDs using the 3D XPoint technology could be 'plug and play' with any modern PC. The only question is when that will happen. Back in mid-summer, some Intel road maps leaked, indicating a very-late 2016 launch. As we write these words in the dying days of 2016, that still hasn't happened.

More recently, there has been talk of Optane drives launching with Intel's new Kaby Lake seventh-generation Core processors. But just to really confuse things, those Optane drives are mooted at 16GB and 32GB capacities. In other words, so small that the implication is that they are cache drives, not mass storage SSDs.

The bottom line is that Optane isn't out as we go to press, and it's not clear when that will happen, or what form it will take. We still think it will be a killer technology – and with any luck, 2017 will be the year it finally delivers. In the meantime, 2017 will see ever faster variants of what you might call conventional SSDs, but it will still look pretty exotic. Samsung's new 960 Pro is likely a harbinger of things to come. M.2 and PCIe SSDs with GB/s of bandwidth will probably be fairly routine by the end of 2017.



SSDs continue to push forward both in terms of capacity and throughput.

HIGH DYNAMIC RANGE IS COMING

Get your retinas ready for HDR screens.

Conventional wisdom has it that screen technology usually develops gradually, and is only occasionally punctuated with major developments. If that's true, somebody has gone crazy with the exclamation marks of late when it comes to PC monitors. The pace of change is almost out of control, and 2017 looks set to see more of the same.

We've already seen so many innovative new features become mainstream in the last 18 months or so. How about frame-synching tech, such as Nvidia's G-Sync and AMD's Freesync? Or high refresh panels capable of 144Hz or more? Or curved screens, super-wide aspect ratio screens, 4K screens and more?

For 2017, all of those features should become ever more affordable. But the really big news is likely to come in two forms. The first, and the one that's a dead cert, is HDR, or high dynamic range technology. In simple terms, it means screens will be both brighter and darker – they'll operate over a wider range. If that sounds a little abstract, in practice it means screens with staggering levels of visual pop and vibrancy. So now that 4K has arrived and given us millions and millions of pixels, HDR is all about making each pixel work much harder.

HDR is a technology that's already rolling out across much of the HDTV market, and at relatively affordable prices. Indeed, there's nothing stopping you from picking up an HDR HDTV, running it with one of the latest Nvidia or AMD GPUs via HDMI 2.0, and getting in on the action immediately. The only snag is that HDR content, particularly games, is extremely scarce. Still, buy an HDR panel now, and you'll benefit from features such as much improved contrast and local backlight dimming. For that reason, we're very much looking forward to the first dedicated HDR computer monitors in 2017.

The other piece of the 2017 puzzle for screens is the ever-tantalising promise of OLED technology. OLED HDTVs finally got some traction in 2016, albeit at a hefty price, and a couple of OLED laptops popped up, too. We still don't expect OLED to go mainstream in 2017, but it should become gradually more prevalent. So depending on where you are in your monitor upgrade cycle, and no matter how tempting a conventional LCD panel may be, even with HDR capabilities, it might just be worth holding out for that OLED awesomeness.

High dynamic range is set to shake up the screen market once more.

NETFLIX 4K COMES TO THE PC

The future of 4K is streaming, and with Kaby Lake, our PCs are back in the mix again.

4K TVs are now a dime a dozen. In that sense, you'd be mad to buy a new HDTV that wasn't 4K. That's true despite the fact that there's relatively little 4K content to watch. For the PC, however, the same logic doesn't quite apply. At least, it hasn't done up until now.

That's because what little 4K content does exist hasn't tended to be available on the PC. Mainly, that reflects DRM and pirating concerns, which meant streaming video providers like Netflix have declined to open up their 4K streaming for the PC. It's been reserved for closed set-top boxes and smart TVs.

However, that could all be set to change with the introduction of Intel's new Kaby Lake seventh-generation Core CPUs, known as the 7000 Series. The big news involves new DRM features built into Kaby Lake's 2D video engine. Reportedly, it could be enough to convince Netflix and other rights holders that the PC is now sufficiently secure for premium 4K content streaming. For sure, Intel has confirmed that Kaby Lake will be certified for Sony's 4K movie and television streaming service, known as Ultra, sometime in 2017. So... fingers crossed.

Another aspect of Kaby Lake that could make having a 4K monitor worthwhile again relates to that new 2D video engine. It has full fixed-function hardware acceleration support for the most important 4K video codecs – HEVC 10 and Google's VP9. The upshot is that a Kaby Lake chip can decode eight 4K streams in parallel. In other words, pairing a Kaby Lake thin-and-light laptop with an external 4K monitor is a goer in terms of 4K video. For games, not so much. But all in good time. ■

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Apple MacBook Pro with Touch Bar (15-inch, Late-2016)

The OLED Touch Bar promises to revolutionise shortcuts, so is it worth the cost?

When it comes to choosing the right MacBook Pro model, it's not just size that usually differentiates the 15-inch models from the 13-inch models. If what you need is high performance, the bigger Pro is where you get it. This is the top-end 15-inch model, in which all components bar memory are improved over the $3,599 base-level model's 2.6GHz processor, AMD Radeon 450 Pro graphics, and 256GB of storage. Both models feature the new Touch Bar.

Let's get straight to the Touch Bar. This adaptable strip shows different options depending on what you're doing. Select a file in Finder and it shows options, such as to add tags. Select text in Pages and it shows formatting options. Create a table in your document and it displays controls to add rows or columns. System dialog options are shown to save choosing one with the trackpad.

Physically, the bar feels great, with a super-smooth matte finish that's different to the iPhone or Apple Watch's glass. It's great at resisting reflections, though the screen quality is a little disappointing compared to Watch's similar OLED screen, and the pixels seem to sit quite deep under the surface. Brightness adjusts automatically, using a separate ambient light sensor to the one for the display and keyboard backlight. You have no control over this – and we're unsure Apple has got it quite right. Usability isn't affected in practice, but we had hoped for a little more vibrancy.

The bar's potential is best revealed in apps like Keynote, where formatting text normally requires switching to the Text pane. The bar's context-sensitive nature means you no longer have to; with the Arrange pane open, when you click a text box, formatting options appear on the bar. You effectively have two panes open at once, affecting the same box, without extra windows obscuring content.

Shortcuts on the bar are more flexible than key combos, being able to show submenus or precise controls. Pixelmator, say, shows brush size sliders you control with one hand, while your other hand stays on the trackpad.

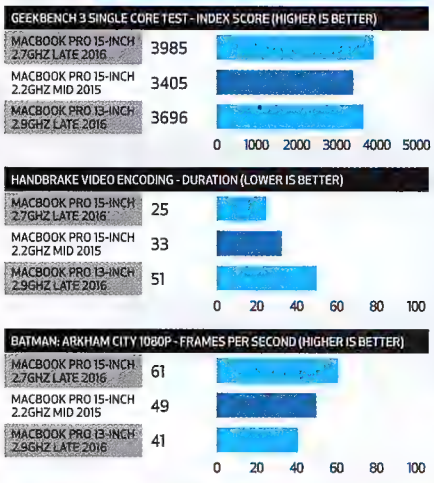
In System Preferences, you can choose whether the Touch Bar shows app controls and a collapsed Control Strip (some of the features that were previously on the function keys) or just one of those, and what's shown when Function is held down – numbered function keys are an option. You can rearrange items, controls, and add new ones in some apps, too.

Is the Touch Bar worth all the fanfare? It depends on how your apps use it, and your habits. We're using it a lot in Pixelmator and iWork apps, but it has little impact on writing or in Photos, use in iMovie is minimal, and you can't see what's going on in Safari's tab thumbnails (though it's nice when your favourite sites' icons are shown). Still, it didn't take long for us to start reaching for the Touch Bar on other Macs, which tells you something. That's also true of the Touch ID sensor at the bar's right end. Once you start using it, you're completely sold, just like on iPhone.

LET'S GET GRAPHICAL

The processor and graphics capabilities are the real meat here. The quad-core processor makes a huge difference over the dual-core chip in 13-inch models. It finished our video encoding benchmark in just 25 minutes – better than half the time – and

LABS BENCHMARK RESULTS


GEEKBENCH 3 SINGLE CORE TEST - INDEX SCORE (HIGHER IS BETTER)
MACBOOK PRO 15-INCH 2.7GHZ LATE 2016
3985
MACBOOK PRO 15-INCH 2.2GHZ MID 2015
3405
MACBOOK PRO 13-INCH 2.9GHZ LATE 2016
3696
0 1000 2000 3000 4000 5000
HANDBRAKE VIDEO ENCODING - DURATION (LOWER IS BETTER)
MACBOOK PRO 15-INCH 2.7GHZ LATE 2016
25
MACBOOK PRO 15-INCH 2.2GHZ MID 2015
33
MACBOOK PRO 13-INCH 2.9GHZ LATE 2016
51
0 20 40 60 80 100
BATMAN: ARKHAM CITY 1080P - FRAMES PER SECOND (HIGHER IS BETTER)
MACBOOK PRO 15-INCH 2.7GHZ LATE 2016
61
MACBOOK PRO 15-INCH 2.2GHZ MID 2015
49
MACBOOK PRO 13-INCH 2.9GHZ LATE 2016
41
0 20 40 60 80 100

"Shortcuts on the bar are more flexible than key combos, being able to show submenus or precise controls."

it's a solid gain over the 33 minutes it took last year's 2.2GHz 15-inch model. That boost could make a big difference to tasks that use the processor well.

In our *Batman* gaming benchmark, the 15-inch's Radeon 455 Pro gave almost a 50% improvement over the 13-inch's integrated Iris Graphics 540 chip. In *Tomb Raider*, the Radeon reached 46.3fps to the Iris's 29fps.

Games tell us a lot about a GPU's power, but in a pro machine like this, rendering 3D real-time visuals isn't always how it'll be used. Many apps, such as Photoshop and Final Cut Pro, use the GPU's huge power to quicken some tasks. In LuxMark, which tests a GPU's speed at OpenCL computations (leveraging the GPU for computing data), the Radeon scored 4,207, while the Iris got 2,700. This can make a big difference to really high-end tasks, but you'll notice it less than you might think for mid-level work. Duplicating layers and adding effects to a huge raw photo in Pixelmator, the Radeon's smoother to work with, yet the Iris is fine for occasional work.

We also tested the Radeon Pro 460 – a custom build option. Its 4GB memory is double the 455's. LuxMark rated it 4,566 – not even 10% better. It's the same for games. To be worthwhile, you must use apps like Motion or 3D rendering tools that use the extra memory.

MEMORY LIMITATIONS

Both 15-inch models have 16GB of memory, which is a great starting point for pros but it's also the end point. The Intel chips used here don't support 32GB of the low-power memory Apple uses to prolong battery life. Most will fare fine with 16GB, but it's limiting for some higher-end work. However, having to send data to and retrieve from storage isn't such a hardship given incredible read speeds of 3,231MB/sec and 2,226MB/sec writes.

Storage and memory are soldered onto the logic board, so you must future-proof when you buy. The four USB-C ports work with USB 3.1 (Gen 1 or 2) and Thunderbolt 3 devices, but barely anything uses the USB-C connector right now, so you'll need adapters. These are inexpensive, though a good dock can cost quite a lot. There are bizarre issues too, such as Mini DisplayPort adaptors being hard to find, yet lots of pro displays use it. We get why Apple changed ports, but you'll need to consider the extra costs and hassle.

The new keyboard has very short travel, and the speakers are massively improved compared to previous models – though for pro audio work, you'll want to use headphones or external monitor speakers.

Battery life is still all-day for light work, with screen brightness lowered slightly. You can drain the battery in a little over two hours by letting After Effects run wild but you can get nine hours of use by avoiding intensive apps.

Matt Bolton

Verdict

Features	★★★★☆
Performance	★★★★☆
Value	★★★☆☆

Good performance, Touch Bar is great for some apps, yet the $3,599 model's components are all nearly as fast.

★★★★☆

"Everything that's wrong with the Rift has nothing to do with the controller and yet, because they're inseparably tied together, the Touch inherits the headset's shortcomings."

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Oculus Touch

It feels like we've got Oculus Rift 2.0.

With the arrival of the Oculus Touch VR controllers, the tides are about to turn on HTC Vive's dominance in the VR headset arena.

Connect your new sensor to an open USB 3.0 port on your PC and sync the controllers. This setup process isn't nearly as smooth as it should be. We've had problems getting Oculus up and running in the past, and the Touch can be just as finicky as the headset itself.

Like the HTC Vive, you'll need to use both the motion controllers and the sensors to map the area around your play space. Oculus's advice is that the sensors should be placed parallel on your desk and be facing forward.

Everything considered, Oculus Touch follows a similar design style to the HTC Vive's controllers (reviewed in *APC* 428, page 70). Both end in a plastic ring, which is used by the cameras to track the controllers, and both offer grip and trigger buttons. Where Oculus Touch differs slightly is that it's a bit smaller than the Vive's pads — the rest of the controller is around the size of one half of a gamepad — and sports two letter buttons, an analog stick and two triggers. Another difference is that, unlike the Vive, the left and right Touch controllers are actually different. The button layouts are on opposing sides, and while the right controller has 'A' and 'B' buttons, the left has 'X' and 'Y'.

Oculus also sports extra buttons on the face of the controller, a trigger, menu and start buttons, a set of grip buttons that hang off the inside wing and a small touch sensor for your thumb next to the joystick. What that means is the Touch can tell what almost every finger is doing at a time.

Every wireless controller needs a battery. While HTC has opted for a rechargeable Lithium-ion one inside of every controller, Oculus uses good ol' AAs, giving you about 30 hours of battery life on a single charge.

Oculus has promised the world 53 Touch-compatible games on Day One. The games will be a mix of completely new titles, games that were already out on Oculus but now have Touch support and games ported over from the HTC Vive and PlayStation VR. It's a varied and actually fun bunch of titles from the wacky, multiplayer shooter *Dead and Buried* from Oculus's own game studio to the self-explanatory *Fruit Ninja VR* and *VR Sports Challenge*. The majority of games we played over the last week were fun and immersive and, compared to the Rift's original launch, are near Game of the Years.

Everything that's wrong with the Rift has nothing to do with the controller and yet, because they're inseparably tied together, the Touch inherits the headset's shortcomings. Oculus doesn't package every controller with the proper equipment for room-scale VR. You'll either need an extension cable for your second sensor and/or opt for the third sensor for more accurate 360-degree tracking. Plus, the Touch *needs* to be a pack-in peripheral for the headset itself, as it enhances the experience in so many ways.

The Oculus Touch took a long time to get here, but we can now say with the utmost certainty that is was well worth the wait. Offering better finger tracking than HTC Vive alongside more overall buttons and slim, form-fitting design, the Touch is the best motion controller on the market that's tied, unfortunately, to hardware stuck in the number two spot. ■ **Nick Pino**

Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★★☆

Exactly what the headset needs, but the lack of room-scaling out of the box means the Vive still has the upperhand.

★★★★½

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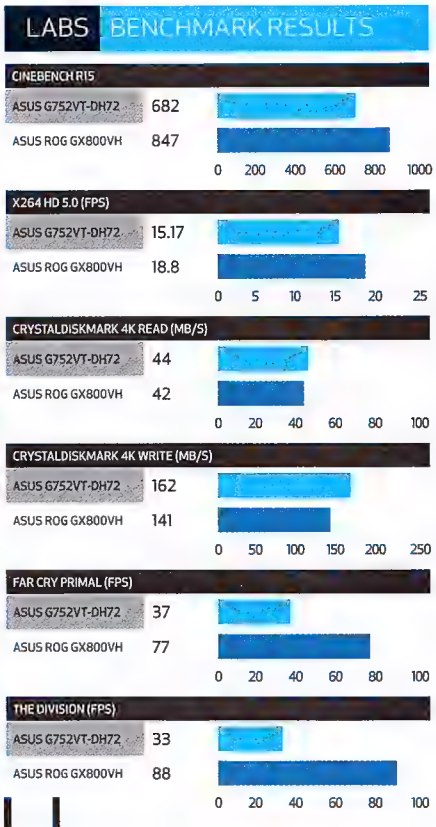
LABS BENCHMARK RESULTS
CINEBENCH R15
ASUS G752VT-DH72 682
ASUS ROG GX800VH 847
0 200 400 600 800 1000
X264 HD 5.0 (FPS)
ASUS G752VT-DH72 15.17
ASUS ROG GX800VH 18.8
0 5 10 15 20 25
CRYSTALDISKMARK 4K READ (MB/S)
ASUS G752VT-DH72 44
ASUS ROG GX800VH 42
0 20 40 60 80 100
CRYSTALDISKMARK 4K WRITE (MB/S)
ASUS G752VT-DH72 162
ASUS ROG GX800VH 141
0 50 100 150 200 250
FAR CRY PRIMAL (FPS)
ASUS G752VT-DH72 37
ASUS ROG GX800VH 77
0 20 40 60 80 100
THE DIVISION (FPS)
ASUS G752VT-DH72 33
ASUS ROG GX800VH 88
0 20 40 60 80 100

ASUS RoG GX800VH

One laptop, two power bricks? That'll be ASUS's new gaming monster.

With the RoG GX800VH, ASUS is positively spurning portability. This is possibly the least portable laptop ever. It's a monumental 18-inch beast. In fact, even the 18-inch metric doesn't do it justice. Thanks to generous bezels around the screen, it could easily accommodate a 19-inch panel. But that's just the beginning.

Not only does it come with two enormous 330W power bricks, both of which must be used to achieve full performance, there's also a meaty docking station, which houses liquid cooling for the two Nvidia graphics chips inside the laptop itself. Total mass comes in at approximately 10.4kg.

The GPUs are a pair of desktop-spec Nvidia GeForce GTX 1080s, and the 18-inch display is a full 4K item, with IPS technology, and Nvidia G-Sync support. Next up is 64GB of RAM and a trio of 512GB Toshiba NVMe SSDs. The only relative disappointment is the Intel Core i7-6820HK. It's not bad per se, but if there's room for a pair of desktop GPUs with liquid cooling, you might think ASUS could have found a way to squeeze in a full-on LGA2011 CPU.

That water-cooling dock is there for the GPUs primarily, but also cools the CPU and even the RAM. You simply drop the rear of the laptop on to the dock, courtesy of the guide pins, and use the metal clasp to secure the self-sealing valves for the liquid-cooling array. It sounds like an accident waiting to happen, but it works well.

ASUS provides a handy desktop software tool that delivers easy access to global settings, and hand-tuning for expert overclocking. It's clever enough to detect when both power supplies are connected, and jump to a higher performing mode.

With a single PSU attached, the CPU clock is capped at 3.6GHz, and the GPUs run at 1,190MHz. Add the second PSU, and those numbers jump to 4.2GHz and 1,771MHz. In theory. If there's a problem with this, it's the complexity. The configuration options are borderline baffling. You can run connected to the dock with one or two power supplies, or run the laptop by itself on purely air cooling and a single power supply. Of course, there's the SLI graphics, which make getting consistent performance out of any machine more complicated.

To cut a long story short, we tried the GX800VH in every imaginable configuration, and ran most of our benchmarks in each configuration to investigate the impact of adding the second PSU, and running with and without the liquid cooling. The results were always fast but also consistently inconsistent. Depending on the test in question, it wouldn't always run faster with the second power supply plugged in. Some games ran faster in some configurations at 4K than 1080p. The numbers were all over the place.

In mitigation, even at its worst, the GX800VH is one hell of a fast laptop. Games look fantastic and run pretty well at 4K. Our review sample was also pre-production, with some features – including G-Sync support – missing. ASUS is working on final refinements for retail models.

This is a very complex machine, and there's no doubt that a conventional desktop is the better route to a high-performance PC that does its thing with consistency. It really is that simple. ■ **Jeremy Laird**

Verdict

Features	★★★★½
Performance	★★★★
Value	★★½

Massive spec, huge performance and intriguing bespoke engineering, but pricey, non-portable and inconsistent.

★★★½

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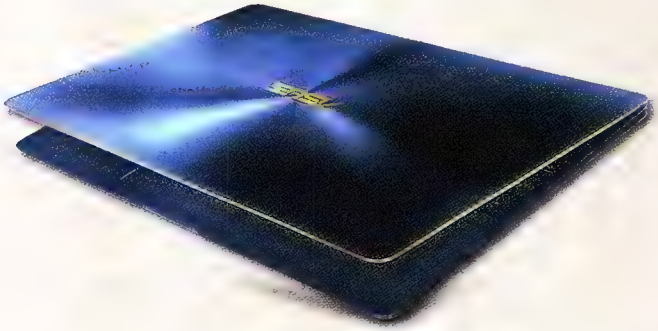

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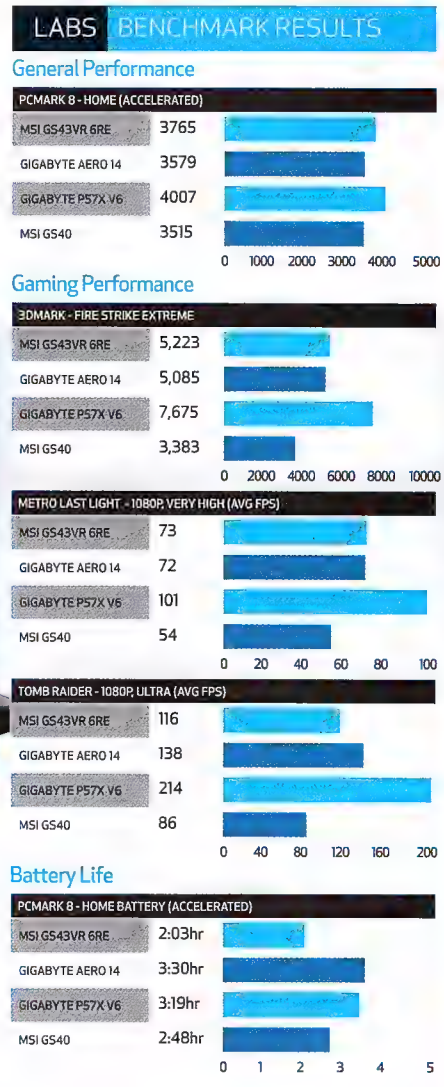
LABS BENCHMARK RESULTS
General Performance
PCMARK 8 - HOME (ACCELERATED)
MSI GS43VR 6RE 3765
GIGABYTE AERO 14 3579
GIGABYTE P57X V6 4007
MSI GS40 3515
0 1000 2000 3000 4000 5000
Gaming Performance
3DMARK - FIRE STRIKE EXTREME
MSI GS43VR 6RE 5,223
GIGABYTE AERO 14 5,085
GIGABYTE P57X V6 7,675
MSI GS40 3,383
0 2000 4000 6000 8000 10000
METRO LAST LIGHT - 1080P, VERY HIGH (AVG FPS)
MSI GS43VR 6RE 73
GIGABYTE AERO 14 72
GIGABYTE P57X V6 101
MSI GS40 54
0 20 40 60 80 100
TOMB RAIDER - 1080P, ULTRA (AVG FPS)
MSI GS43VR 6RE 116
GIGABYTE AERO 14 138
GIGABYTE P57X V6 214
MSI GS40 86
0 40 80 120 160 200
Battery Life
PCMARK 8 - HOME BATTERY (ACCELERATED)
MSI GS43VR 6RE 2:03hr
GIGABYTE AERO 14 3:30hr
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0 1 2 3 4 5

Gigabyte Aero 14

Built on the strong foundations of a new GPU architecture.

After having our grubby mitts on some laptops sporting Nvidia's latest Pascal GPUs, we can safely say that this architectural update makes a big difference to notebook efficiency, gaming performance and size. Though the Aero 14 has appeared in an earlier incarnation with a GTX 970M, we can't help but feel that the Aero 14's design was really built to house one of Nvidia's cooler-running Pascal GPUs – and it demonstrates what a fantastic, no-compromise portable you can create around the GTX 1060.

Nvidia's not calling this GPU a '1060M', which is not a typo, rather a new Pascal naming convention. Since you get identical memory bandwidth, CUDA cores and similar performance (less than a 10% difference) across both desktop and laptop GPUs, Nvidia's decided there's no need to distinguish them. To go along with this near-desktop-grade GPU, the Aero 14 also packs a top-of-the-line Intel Core i7-6700HQ CPU that boosts to 3.5GHz, a 14-inch QHD display, 16GB of DDR4 RAM and a generous 512GB PCIe SSD that makes load times super fast. You can boot up to the Windows login in 15 seconds and it'll clock sequential Q32T1 read speeds of 2,193MB/s and writes of 1,580MB/s. Getting double the PCIe SSD storage of most of the competition at this price makes the Aero 14 a compelling proposition, but it's worth noting that you will have to sacrifice a secondary HDD – and live within that speedy-but-confined 512GB capacity.

It comes in an orange-coloured variation, but we tested the subdued black scheme, which can pass as a work computer. It was able to achieve some of the best PCMark 8 benchmark results in home and work use cases, with scores of 3,579 and 4,427. This was followed by similarly good results in HWBOT's CPU-heavy x265 media-encoding test, where the Aero 14 managed to crank through an impressive 15.95fps with 1080p video.

Moving on to GPU tasks, this device pulled out a score of 5,086 on 3DMark's graphically challenging Fire Strike Extreme – just a little lower than ASUS's $7,500, GX700, which scored 5,881 (and features two desktop-grade GTX 980s in SLI and 64GB of RAM). In real-world tests on *Batman: Arkham Knight*, *The Division* and *Far Cry Primal*, the Aero 14 flipped 64, 53 and 44fps using Ultra 1080p settings. These figures are notably higher than the mid-2016 ASUS Strix GL502V, showing the boost 10-series Nvidia CPUs offer over their 9-series predecessors.

This relatively-compact laptop is poised for gaming and productivity – and everything from the beefy internals to the keyboard's customisable macro key bar offers more than what you expect at this price. It's even VR-ready, weighs in at a portable 1.89kg and manages to pack into a sub-2cm profile. It also kept the CPU under 86°C and the GPU under 78°C throughout testing – and didn't get particularly noisy either.

Much of what makes this laptop so successful is the implementation of the new GPU, but its overall composition actually makes it an interesting value proposition for those wanting a faster and streamlined portable-PC experience.

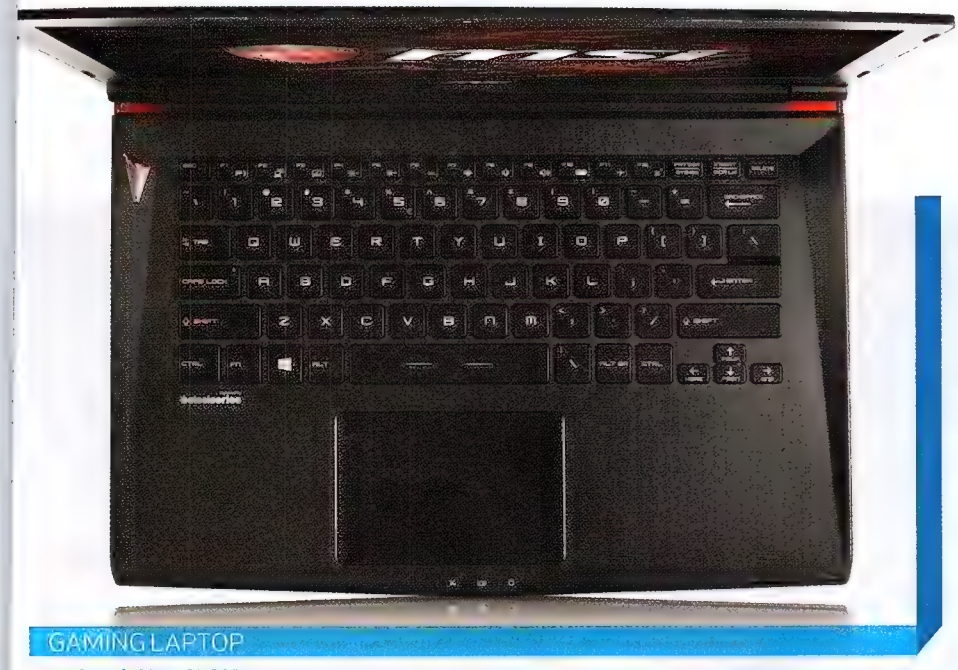
Joel Burgess

Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★★½

Compact and capable, this 14-inch gaming laptop is cool, quiet and well-specced.

★★★★½



GAMING LAPTOP

$2,699 | AU.MSI.COM

MSI GS43VR 6RE Phantom Pro-025AU

A familiar gaming laptop cocktail that missed the opportunity for a twist.

For the past few years, the performance offered by laptop GPUs has meant that 1080p resolution screens offered, arguably, the best balance of resolution and framerate in mid- and entry-level gaming laptops. But when you consider that the latest update to MSI's GS43VR 6RE features a GTX-980-beating GeForce GTX 1060 GPU, it's hard not to want to match some of that power with a higher-end screen. Unfortunately, MSI didn't seem to share this thought and opted for a simple matte 14-inch 1,920 x 1,080 display.

The GS43VR 6RE is similar in shape but slightly lighter than the GS40 that we tested back in March 2016, with both 14-inch units being around 2.3cm thick and weighing 1.6kg and 1.8kg apiece. There were also no surprises when it came to the layout and and design of the black plastic case with red accents, side and rear fan vents, and a slightly left-of-centre trackpad.

The unit's Intel Core i7-6700HQ CPU, 16GB of DDR4 RAM, 256GB SSD, 1TB HDD and 14-inch FHD IPS LCD display amount to a spec sheet that's imbued with a sense of déjà vu. Though we'd normally be fine with this as it represents a well-honed product, there are a couple of things we see as missed opportunities.

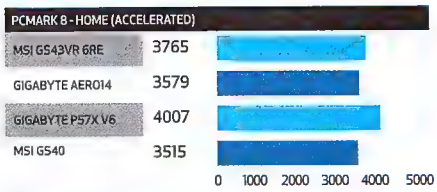
It's worth reiterating that, if you have the GPU to run the latest gaming titles on Ultra settings using a widescreen 1440p output, then it's a shame the inbuilt display doesn't match. While MSI wasn't the only vendor to miss this opportunity, Gigabyte's Aero 14 (see left) shows it can be done, offering both a GTX 1060 and a 14-inch QHD screen.

There's still a lot to like about the GS43 6RE. Its overall performance is a significant step forward from the previous GS40. The 256GB Samsung M.2 SSD is a speedy PCIe unit, so you get 2,333 and 1,298MB/s read and write speeds on the hard drive that your OS runs from, with enough room to store a handful of games. This little workhorse was also able to outpace the Aero 14 on both PCMark 8's Home and Work benchmarks, scoring 3,765 and 4,750 compared to the latter's respective 3,579 and 4,427.

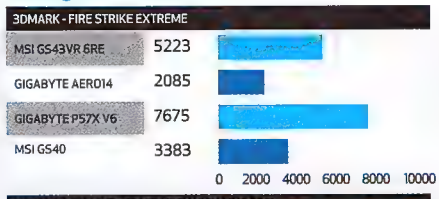
MSI's implementation of a Nvidia GTX 1060 comes with the expected boost for GPU tasks, though the thermal performance isn't the best: this unit runs hotter than Gigabyte's, with a maximum GPU temperature of 83°C over the Aero's 78°C when under load. When the two units face off, there's a bit of to and fro, but for the most part the scores are close. The Aero 14's average of 94fps beats the GS43's 91fps in *Batman: Arkham Knight*, while the Aero 14's 138fps average in the *Tomb Raider* benchmark was fractionally outpaced by the GS43's 142fps average on 1080p Ultra settings. The flaws here aren't deal breakers and everything else on offer is up to scratch, and the performance boost of that new GPU adds a lot of value when compared to older units. We wouldn't be at all disappointed if MSI's GS43 6RE was our gaming laptop, but then, with Gigabytes' Aero 14 offering a little more for the same price, we know which one we'd pick. ■ **Joel Burgess**

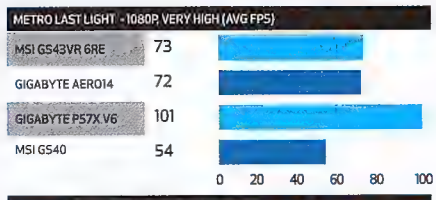
LABS BENCHMARK RESULTS

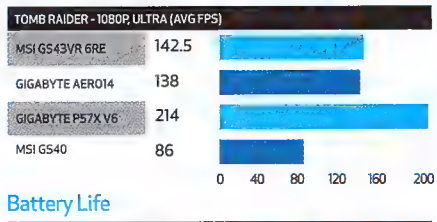
General Performance


PCMARK 8 - HOME (ACCELERATED)
MSI GS43VR 6RE 3765
GIGABYTE AERO14 3579
GIGABYTE P57X V6 4007
MSI GS40 3515
0 1000 2000 3000 4000 5000

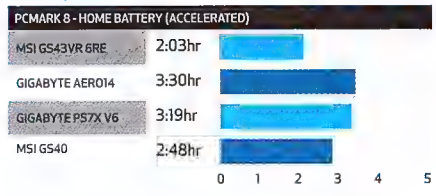
Gaming Performance


3DMARK - FIRE STRIKE EXTREME
MSI GS43VR 6RE 5223
GIGABYTE AERO14 2085
GIGABYTE P57X V6 7675
MSI GS40 3383
0 2000 4000 6000 8000 10000


METRO LAST LIGHT - 1080P, VERY HIGH (AVG FPS)
MSI GS43VR 6RE 73
GIGABYTE AERO14 72
GIGABYTE P57X V6 101
MSI GS40 54
0 20 40 60 80 100



Battery Life


PCMARK 8 - HOME BATTERY (ACCELERATED)
MSI GS43VR 6RE 2:03hr
GIGABYTE AERO14 3:30hr
GIGABYTE P57X V6 3:19hr
MSI GS40 2:48hr
0 1 2 3 4 5

Verdict

Features	★★★½
Performance	★★★★
Value	★★★

A well-rounded gaming laptop that sports a new GTX 1060 GPU, but doesn't do much to differentiate itself.

★★★½

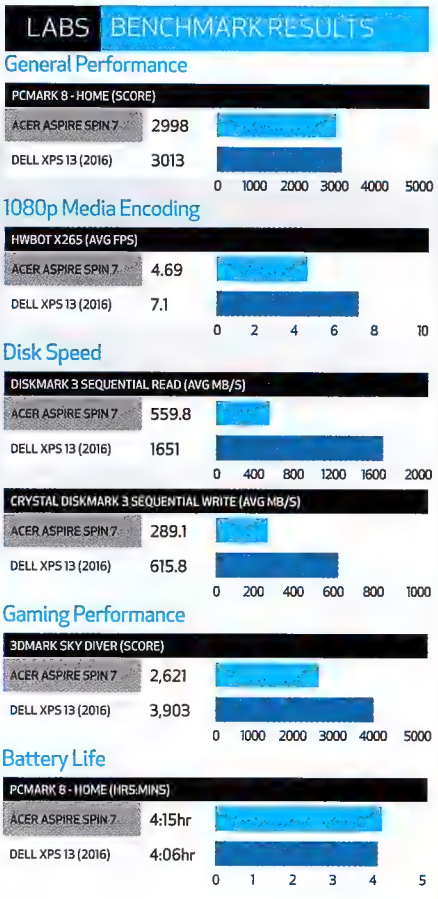
apc RECOMMENDS

LAPTOP

$1,999 | WWW.ACER.COM.AU

Acer Aspire Spin 7

This 2-in-1 might not spin any heads, but it'll certainly turn them.


LABS BENCHMARK RESULTS
General Performance
PCMARK 8 - HOME (SCORE)
ACER ASPIRE SPIN 7 2998
DELL XPS 13 (2016) 3013
0 1000 2000 3000 4000 5000
1080p Media Encoding
HWBOT X265 (AVG FPS)
ACER ASPIRE SPIN 7 4.69
DELL XPS 13 (2016) 7.1
0 2 4 6 8 10
Disk Speed
DISKMARK 3 SEQUENTIAL READ (AVG MB/S)
ACER ASPIRE SPIN 7 559.8
DELL XPS 13 (2016) 1651
0 400 800 1200 1600 2000
CRYSTAL DISKMARK 3 SEQUENTIAL WRITE (AVG MB/S)
ACER ASPIRE SPIN 7 289.1
DELL XPS 13 (2016) 615.8
0 200 400 600 800 1000
Gaming Performance
3DMARK SKY DIVER (SCORE)
ACER ASPIRE SPIN 7 2,621
DELL XPS 13 (2016) 3,903
0 1000 2000 3000 4000 5000
Battery Life
PCMARK 8 - HOME (HRS:MINS)
ACER ASPIRE SPIN 7 4:15hr
DELL XPS 13 (2016) 4:06hr
0 1 2 3 4 5

The Aspire Spin 7 is one of the most attractive 2-in-1s to have passed through the *APC* labs. Weighing 1.6kg and measuring just 22mm thick when closed, this 14-inch convertible is made up of two thin, flat rectangular metal slabs that make the whole package pleasingly symmetrical.

Those two halves are conjoined on one edge by a pair of sturdy silver hinges that lets the screen keep folding around a full 360°, until the back of the display and underside of the keyboard segment are touching. That lack of width does mean you only get USB Type-C ports, although there is a adapter-dongle included so you can still get a regular USB-A port in a pinch.

Acer is only offering one version of the Spin 7 in Australia so far – an upper-mid model in a matte-black finish that has a 1080p IPS display (protected by Gorilla Glass), Core i7 CPU (there's a caveat to that, which we'll get to later), 256GB SATA SSD and 8GB of memory for $1,999. That's a fair deal for that mix of specs and price and the fact that the keyboard and ultrawide trackpad are both super-responsive and comfortable in use helps the appeal too.

Did we mention this really is a very thin device? And yet, despite that, it's also passively cooled – there are no fans inside to help dissipate heat. There's not even any vents. It's dead silent at all times: you won't hear a peep out of it, even when it's doing serious number crunching. There's still a price to pay, though, in that if you do anything moderately CPU-intensive, the chassis area behind the keyboard heats up to scorching levels that are literally too hot to touch – and on the underside, too.

Causing most of that heat is Intel's deceptively named Core i7-7Y75 processor. Don't let the 'i7' moniker fool you: last year, this ultra low-voltage CPU would have carried the 'Core M' name, but for some reason, Intel has decided to rebadge its new Kaby Lake Core M chips so they get the same 'Core i3', 'i5' and 'i7' identifiers as its mainstream parts... even though they're substantially less powerful. (You can generally spot these chips because they have a Y in their four-digit identifier number). That's not to imply that the Spin 7 is slow – it holds up very well for day-to-day tasks – but we wouldn't want to be doing taxing tasks like editing or encoding 4K video on it, and it's only capable of very basic gaming.

The battery life was just fair in our testing – about what we'd expect from a laptop this thin. It eked out a passable 4 hours in PCMark 8's Home benchmark – a moderate-use test including web-surfing, video chat and office document editing – and that stretched to 6 hours when we were just watching 1080p videos. (Our battery tests are run with the screen at 50% brightness.)

We did experience one niggling issue with the Spin 7 during our entire time with it – its matte-black metallic finish is a massive fingerprint magnet. It quickly becomes grubby, which undermines its otherwise premium look and feel. That'll bother some people more than others – but regardless, it's an issue that means we'd suggest seeing and testing this 2-in-1 in person before deciding if it's right for you.

Dan Gardiner

Verdict

Features	★★★★
Performance	★★★★
Value	★★★½

A super-sleek and symmetrical 2-in-1 that has lots of appeal — even beyond its good looks.

★★★★☆

IPS MONITOR

$399 | WWW.VIEWSONIC.COM.AU

ViewSonic VP2468

Is this really a pro panel for a puny price?

Four hundred bucks. That's all you need to stump up for a 24-inch, full HD, IPS, multi-input, fully-adjustable PC monitor.

If that's the new norm, it's also the highly competitive context in which the VP2468 must strut its stuff. The good news is that its feature set does indeed go a little beyond that norm. For the record, it begins with the aforementioned IPS panel and its 1,920 x 1,080 pixels. Inevitably at this price point, it's almost certainly a 6-bit-per-channel panel in hardware terms, and uses dithering to achieve the claimed 16.7 million colours.

However, the VP2468 also supports 14-bit 3D look-up tables, plus six-axis colour adjustment functionality. Both are a little unusual for this class of display, and elevate the VP2468's utility beyond the budget-monitor masses. Its static contrast, meanwhile, is rated at 1,000:1, the maximum refresh at native resolution is 60Hz, the backlight is a simple white LED affair, and max brightness is 250cd/m2. ViewSonic has also thrown in a decent array of input options, including two HDMI inputs, both full and mini DisplayPort connectors and a DisplayPort-out for daisy chaining. Nice.

But if there's anything that really makes the VP2468 stand out visually, it's the bezels. There are numerous affordable monitors with slim bezels on three sides, but the VP2468 ups the ante to all four. The result is a pleasingly minimalist design, and one that looks conspicuously compact for a 24-inch panel. The fully adjustable stand with swivel, rotate, tilt and height tweakability is a welcome inclusion, too.

All of which just leaves the minor matter of how this display performs. The VP2468 is pitched as a cheap solution for professional applications, and with that in mind, each panel comes factory calibrated, complete with a printout of the results, and a promise that all colour deltas are below two. The upshot is a nicely set-up display, with excellent detail in both black and white scales. As you'd expect from an IPS display, the viewing angles are excellent, too.

Another plus point concerns the two-tier OSD menu. With both a simple menu for frequently used settings and a fuller option that includes more settings, it's extremely pleasant to use. The only obvious omission is an option for adjusting the pixel overdrive. That brings us to the first of the image quality issues. The pixel response is mediocre. Worse, there is occasionally some fairly obvious inverse ghosting with certain colours and shapes. The likely fact that this is a cheap 6-bit IPS panel is all too obvious when viewing colour gradients. The tell-tale banding is, sadly, clearly evident.

We're not crazy about the contrast, vibrancy and colours, either. We had a 4K TN monitor running in parallel during our review process, and it had this ViewSonic comprehensively beaten for subjective contrast and colour vibrancy. The comparison also highlighted a lack of punch from the backlight, and a slight dirtiness to the quality of the white tones.

Of course, this is an affordable $399 screen, it has a strong feature set, and its shortcomings are largely generic. Cheap 6-bit IPS panels aren't pretty. We advise throwing a few more dollars at your display to get yourself something better.

Jeremy Laird

Verdict

Features	★★★
Performance	★★★½
Value	★★★½

Strong feature set, slick slim-bezel design, affordable option for graphics pros, but not ideal for most.

★★★½

NAS BOX

$849 (BOX ONLY) | DROBOWORKS.COM.AU

Drobo 5N

A five-bay network storage box with hot-swappable drives.

Drobo has built its business on storage systems that allow you to mix and match disks of different speeds, capacities and manufacturers and hotswap them when you need to add capacity or replace a failing disk. The Drobo 5N provides all these features and many more.

First the name: the '5' is a reference to the number of hard drive bays able to be filled and the 'N' to the fact that this is a network storage device. To that end, the Drobo 5N has a Gigabit Ethernet port that enables you to connect it to your router – or directly to your Mac if you want to copy lots of data at the fastest possible speed.

The 5N has one additional storage slot, into which you can fit an mSATA SSD to use as a cache of the files you use most often, in a similar way to Apple's Fusion Drive. If you want, you can fit SSDs in the other five disk bays, too, but this is much more costly than using hard disks, prohibitively so for most of us, and unnecessary. The configuration of the SSD/hard disk arrangement, like that of everything else in the 5N, is automatic.

The 5N has built-in redundancy, so if a disk fails the storage array is automatically reconfigured to avoid using that one and rebuilds the storage plus redundancy setup using the remaining disks. You can then whip out the failed disk, slot in a replacement and the drive rebuilds the array to include it.

Setting up is straightforward enough – hard disks and SSDs are easy to slot into position. We experienced one or two hiccups while the Drobo Dashboard software was configuring the 5N, however. It seemed to take an age to find the drive on the network and then it insisted on updating the firmware. Once done, the 5N restarted automatically but again took several minutes to be 'found' by the software. Once the unit had been discovered, the manual prompts users to set up an admin password, but doesn't mention the need to wait 20 minutes for the 5N to configure itself.

Once set up, the 5N worked like a charm. It took six minutes to copy 24GB of data from our iMac, and we were able to remove one hard disk and add two more without any interruption to the copying process.

As with many network drives, there are a number of apps you can install on the 5N. These enable you to host a Wordpress blog, use the drive as a DLNA or Plex server, download using BitTorrent, or back up your data to Crashplan, for example. There are also apps that enable access to the 5N while away from your local network, and to simplify moving and accessing photos and videos from a smartphone or tablet to and from the drive.

We have only two minor qualms about the Drobo 5N. One is the noise it makes. It's not excessive, but having it sitting on a desk next to you, you'll definitely notice it. The fan is noisier than the two-bay Synology NAS we regularly use, at any rate.

The other is price. At a shade under $850 for the enclosure alone, the 5N is significantly more pricey than four-bay NAS enclosures. You pay for the convenience of mixing and matching drives and being able to hotswap them, as well as the extra bay. If that's important to you, the 5N won't disappoint. If not, you may be better looking elsewhere.

Kenny Hemphill

Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★½

Drobo 5N is a good but expensive choice for families in need of a robust backup or file sharing system.

★★★★½

DIGITAL STYLUS

$60 | ADONIT.NET/SNAP

Adonit Snap

It might look weird, but this stylus is a joy for writing and note-taking.

There are two problems with most styluses. Firstly, the tips are often too sticky to allow smooth lines to be drawn. Secondly, they are often too large and a little soft, making precision hard to achieve. This is where the Adonit Snap comes into play.

Its slim, brushed metal body feels well made, and it fits nicely in the hand. A single button falls just right on one face – the stylus is flattened rather than rounded – leaving a small LED visible.

Drawing with the Snap is a joy. Its nib is firm and glides rather than skids over your iOS device's display. Having just the right amount of friction is the key to success for any stylus, and this one gets it just right. It doesn't feel like your traditional pencil and paper, but more like a modern equivalent for drawing or taking notes in an art app.

Although seemingly gimmicky, one useful feature is the single button on one side of the stylus. This can act as a shutter button for your camera app. It comes in useful if you're a selfie fan who wants to avoid the stretched arm shot, or if you can't hold your handset out and reach the shutter button with your thumb – a problem with larger handsets like the iPhone 7 Plus.

Another helpful design feature is that the stylus attaches magnetically to the back of your iPhone, lessening the chances of losing it while on the move.

This isn't the cheapest stylus on the market but it certainly is one of the best, with a natural feel and a couple of useful design features to help with your daily life.

■ Rob Redman

Verdict

A very impressive stylus that we loved using — only let down by its fairly high cost.

★★★★☆

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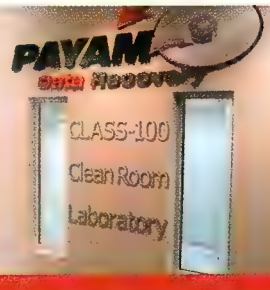

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www.payam.com.au

WEBCAM

$149 | WWW.LOGITECH.COM

Logitech C922 Pro Stream Webcam

Cut out and weep.

Let's address the elephant in the Logitech C922 room: its box-vaunted background replacement feature. This is meant to do a virtual chroma-key, and blot out everything but yourself, making this (in theory) a perfect cam for cost-conscious streamers.

Using a piece of third-party software – Personify Chromacam – whatever happens to be behind you is indeed excised, but it's done with the finesse of an angry toddler carrying a chainsaw. Chromacam routinely hacked off our headphones, and the majority of our arms and shoulders, with strange, wobbling, wavy edges. Sitting stock still and giving it time to adjust just made the problem worse, because it then presumed we were part of the background.

Chromacam isn't this cam's only automatic feature, though, and the rest of it is really rather good. Auto-focus works very well, reacting quickly to distance changes in the central portion of the camera's viewing area, though the edges, with no way to select a particular focus point, are less sensitive. There's a massive focal range, so it captures you nice and sharp wherever you happen to be sitting. The camera's auto low-light correction is also pretty good. Although, as is usual for digital sensors, there's a notable increase in visual noise as the sensor has to work hard to fight the dark. Taking control manually using the bare-bones settings panel, you get access to a limited set of exposure levels, so you won't always find the perfect configuration.

There's also panning, tilting and zooming integrated into the driver – these aren't physical functions, but they're useful if you're a little further away from the camera's massive 78° field of view, and want to crop out your boyband posters and dirty laundry.

With its maximum resolution of 1,920 x 1,080 at 30fps (and a far zippier 1,280 x 720 60fps mode available) tied into some remarkably sharp H.264 compression, the C922 gives you plenty of wiggle room to work with a smaller area of the image when streaming or holding conversations.

Its integrated mic is not something we'd ever record with, and the usefulness of stereo mic functionality in a unit you'll primarily use for Twitch or Skype is debatable. But adding an environmental mic to a desktop PC that lacks one, or upgrading that of a cheaper laptop, is a bonus.

You're not short of positioning options, with a desk tripod in the box, and a stiffly-engineered monitor hook that can be adapted to hang from the top of just about any screen, so it's flexible enough for most potential setups.

The main issue is something else entirely, though. We're utterly spoiled by the devices we have in our pockets, and while phone sensors are improving rapidly, the same can't be said for the sensors we get to play with on the desktop. This is functional and sharp – perfect, in fact, if you just want a webcam – but it's time for the tech, particularly at this price, to take the next step.

Alex Cox

Verdict

Features	★★★½☆
Performance	★★★★☆
Value	★★★☆☆

High resolution, sharp video, automated features and stereo microphone, but doesn't stand out from the crowd.

★★★½☆

GAMING HEADSET

$69 | WWW.HYPERXGAMING.COM

HyperX Cloud Stinger

Budget cans stripped to the bare essentials.

The Cloud Stinger isn't meant to sit in the same niche as its big brother, the Cloud IIs, coming in at half the price. But despite that, this is a neat set of cans, well shaped and sporting memory foam earcups. The headband is roomy and well cushioned, the metal adjustment arms stiff and unmoving, and the earpieces rotate 90°.

However, the four-pole jack cable is only 128cm long, although clicking it into the included dual three-pole adapter rounds the length up to a more reasonable 298cm. Give the faux-leather cup covers a light tug, and that silky cladding moves, and comes away slightly.

There's a discrete on-ear volume control, a nice feature, but this slightly sticky slider jumps between moderately quiet, mildly loud and tinnitus-inducing, with no nuance in between. Our unit also had an unpleasant quirk: use the slider to drop the volume beyond a certain point, and the right ear audio drops out entirely.

Its 30ohm 50mm directional drivers bang out a pleasant soundscape. Bass noise, as is common with gamer-leaning headsets, is thick and boosted, though not to the point of rattling or distortion. The earcups do tend to be a little leaky as soon as you edge above mid-volume, and the mic is keen enough to capture clear conversation without any unpleasant breathing noises.

We would be churlish to judge the Stinger against its godly sibling, but if you have $100 to spend on a headset, there's a world of hardware out there that's better than this. ■ **Alex Cox**

Verdict

Warm sound and lightweight with a good quality mic. Very wearable but not the best in its niche.

PC CASE

$129 | WWW.BITFENIX.COM

BitFenix Aurora

Time to get funky.

The not-so-subtle curves cut out of the front and top exterior panels add a strange aesthetic to the tempered glass chassis, allowing plenty of airflow into the ventilated front panel, without being too obvious about it.

The tempered glass panels sit snug against the Aurora. The smoked side, which reveals all your internal components, cries out for solid internal lighting, while the rear panel is entirely blackened, retaining the look and feel of glass, without showing off the undoubtable mess of cables you have tucked away.

The chassis as a whole follows BitFenix's modular design. Both of the 3.5-inch drive bays are entirely optional, with the upper cage mimicking a 5.25-inch cage, easily removable with the release of four separate screws, one on each side, two in the front.

The two recessed radiator mounts located in the front and the roof of the chassis are neat little additions, adding extra room and helping to show off your fans through the case window. The support for full E-ATX motherboards, coupled with three 2.5-inch bays, is nice as well. We also have to mention the oddity of the front-facing LED SSD mount. It's ASUS Aura-ready, so if you want your SSD to light up the same colour as your motherboard, you can do that... Yeah.

We also wish the soft-touch finish had made its way to the Aurora, and that there was an integrated PSU cover.

It's not the most modern chassis out there, nor does it offer the most features, but it's well rounded and provides a solid base for any PC builder. ■ **Zak Storey**

Verdict

Intuitive radiator support, internal SSD LEDs, tempered glass panels and minor modularity.

PC CASE

$149 | WWW.NZXT.COM

NZXT S340 Elite

Case of the year.

It's hard to sum up just how impressed we are with this $150 lump of perfection. NZXT has always made an impression with its cases – since the launch of its H440 back in 2014, the company has been on a winning streak. Whether it's the bold design of the ITX Manta, or the simple and elegant S340, it seems this chassis manufacturer can do no wrong. So when the Elite – an updated variant of the S340 – launched, featuring the now popular tempered glass side panel, we had to subject it to our scrutiny.

So what's so special about this chunk of design? A combination of a few things. Firstly, you get a small, clean, compact tower. The single tempered glass side panel lacks any smoky tint or garish discrepancies, elegantly showing off the innards of your system.

Delving into the interior, we're amazed by the quality of the paint job. The satin powdered finish coats the insides of the folded steel panels. Nothing catches, everything is smooth, yet still decisively metallic. The black cable-hide bar elegantly snakes up the right-hand side of the interior, easily hiding any ugly cables you might have from view. There are no rubber grommets to be found here – but, honestly, you simply don't need them.

A look behind the motherboard tray reveals a suitably expansive CPU cutout, and a total of four cable grips dotted around – plenty to route any unwanted cables through – with additional cable tie points positioned nearby.

Heading down to the compartmentalised power supply cover, you'll find a mounting cage for two 3.5-inch drives, followed by ample room for your ATX power supply, with plenty of dust-filtered ventilation included. The power supply installs through the rear of the chassis, via a neat screw-mounted bracket, and that's about all there is to it.

Then there's the front I/O, which features power, reset, four USB headers, a mic and headphone jack, and an HDMI passthrough for those VR junkies out there.

Cooling support is a mixed bag. There's room for a 240 or 280mm AIO in the front of the chassis, one 140 or 120mm fan in the roof, and one 120mm fan in the rear. As there's no 5.25-inch bay in the front of the case, the front panel remains solid. However, there's a good inch and a half of separation between the panel and the fan mounting points, ensuring you can retain excellent airflow while keeping that streamlined style. Tthe cooling options are pretty limited, but for most people, three or four intake fans in a chassis like this should be plenty.

So what are the negatives? Well, those of you with OCD may feel a little frustrated by those 2.5-inch SSD mounts situated on top of the PSU cover, screaming for identical drives to be placed in them. When removing those 2.5-inch trays, it could look a little nicer underneath. And we'd happily see a chassis that's a little taller, so you would have a way of mounting a larger radiator or more fans in the roof. But there's little criticism beyond that.

In terms of price, it's an affordable and attractive choice at $149. It's an ATX dream case, with a soft satin touch finish, filled to the brim with little features designed to make the building experience a pleasure for any enthusiast, while continuing to challenge what is the norm in case design. We salute you, NZXT – keep up the good work. ■ Zak Storey

Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★★☆

Fantastic finish, super-sleek design; easy to build in, adequate cooling solutions and for an affordable price!

★★★★½

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software

» APPS FOR ALL THE PLATFORMS

Windows SOFTWARE

Audacity

Flexible and powerful, Audacity is the very best free audio editor available.

FREE | TINYURL.COM/APC437-AUDAC

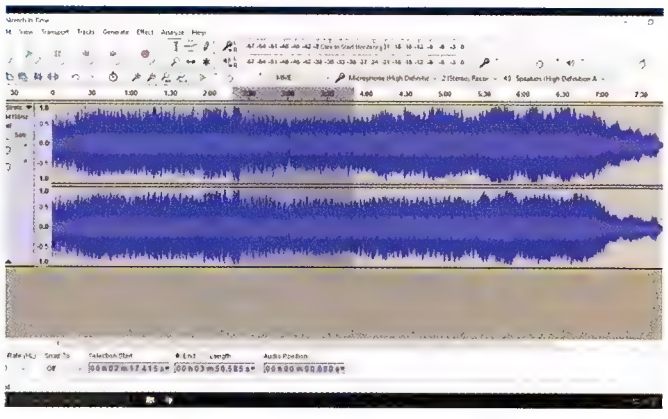
When you want to edit an audio file – whether it's to create a custom ringtone for your phone, make your own podcasts or record music – the prospect of choosing the right audio editor for the job can be a daunting one.

The complexity of some audio editors might be enough to scare you away, but it's more likely to be the price tag attached to such software that sends you running. Never fear, though – there are free options packed with professional-quality features.

Available for any desktop platform you care to mention, Audacity is our first-choice free music editor. It has a huge following, and it's one that is entirely justified. It's a powerful tool that would put some paid-for products to shame, and although the interface might initially seem slightly intimidating, it's actually surprisingly approachable even for beginners.

Audacity is equipped with an extensive suite of built-in tools, enabling you to edit pre-recorded files, capture sound through an attached microphone, or even stream music and podcasts. There's support for a wide range of audio formats for both importing and exporting, and the range of built-in effect is impressive.

You can record audio from both a microphone and computer playback, with sample rates as high as 192,000Hz. Level meters monitor the volume levels during recording useful for spotting clipping. There's also support for recording at 24-bit depth.



You can import and export dozens of different file formats, then easily adjust your files with multi-track editing, smooth fading, labelling, syncing and more. There's also a great selection of third-party plug-ins to make it even more versatile – one of our favourites is autotune add-on Gsnap (**www.gvst.co.uk/gsnap.htm**) for that T-Pain effect – and a comprehensive manual is available to help you to get to grips with the more complicated aspects of the program.

Its sheer power and incredible set of features make Audacity the best free audio editor you can download today. **Mike Williams**

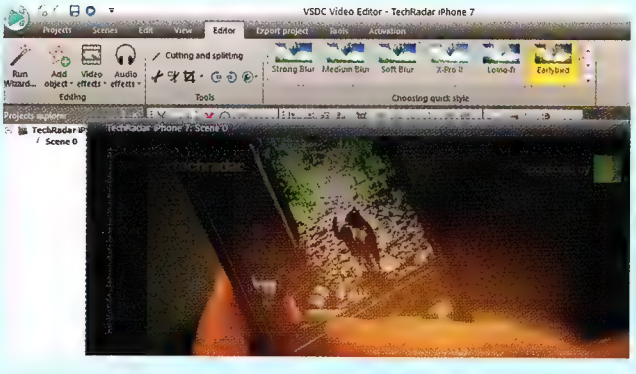
VSDC Free Video Editor

Premium video editing for free? Yes, it's possible!

FREE | TINYURL.COM/APC437-VSDC

Imagine a video editor that enabled you to create projects in 1080p, export in MP4, MKV, AVI, MOV, XVID, DIVX, FLV and MPG, included useful visual and audio effects and could export to DVD and devices such as iPods, Xboxes and phones. Now imagine the price. Many free video editing programs are fairly limited, stuffed with adware or are just horrible, and the very best apps are aimed at pros with deep pockets. So, naturaly, we were surprised when we found out that VDSC is free.

Now that it has dumped its adware component, VSDC Free Video Editor offers decent features with no price tag and no downsides unless you want to work in 4K and/or 60fps. But if you do, you're probably a pro with a software budget to match. It's not the most straightforward app to learn — compared to mainstream commercial editors, it does require you to grapple with a slightly odd way of working, and the interface is dated —



but it's worth sticking with it, because the app does offer a lot of power for a price tag of zero. The app is under constant revision, too, so if you do encounter a bug, it's not likely to exist for very long. It's definitely one to consider before you think about paid-for products. **Gary Marshall**

Final Cut Pro X 10.3

Apple's professional video-editing app gets an update.

$499.99 | WWW.APPLE.COM/AU/FINAL-CUT-PRO

Apple has made key changes to the form and function of Final Cut Pro in this release. Indeed, it recommends you back up your old Final Cut Pro Library before you upgrade it to be compatible with version 10.3, due to the new 'roles' feature. All components of a project are assigned roles (titles, sound, video and effects). When an old projects's multi-channel audio clips are given a role in 10.3, it may change the way that they are mixed. For this reason, it's a wise move to export a major project before upgrading.

The new roles feature makes a project more manageable. Every component in the timeline can be assigned a colour-coded role so it's easier to see where assets such as sound effects and cutaway clips appear. You can create custom roles and subroles (such as ambient sound) and assign them a unique colour. You can group assets in the browser together according their roles, so it's easier to find particular assets. The enhanced Timeline Index lets you focus on clips that have a specific role while collapsing other assets into colour-coded bars. This way of simplifying the timeline makes it easier to work with on a MacBook. Indeed, you can view the colour-coded timeline on the Touch Bar of a new MacBook Pro and jump to a specific part of your project with a tap.

The new Flow transition, which morphs between two cuts instead of dissolving, can make a jump cut in an interview look less jarring, alleviating the need to hide the edit point with a cutaway.

There are interface tweaks, too. For example, the Titles panel used to be near Transitions, but it has now been promoted to a Titles browser. This positions the Titles browser as it is in iMovie. Indeed, with the new sharp lines and black panels, Final Cut Pro X and iMovie look more

similar, which should help iMovie users make the transition. A welcome addition is the option to create layouts for tasks (such as grading) and save these as custom workspaces. You can also now expand the Inspector to the full height of the workspace, which reduces the need to scroll to adjust a clip's particular properties.

So in all, the tweaks and new roles help you manage complex editing projects more effectively. **George Cairns**

Quiri

Who needs Siri?

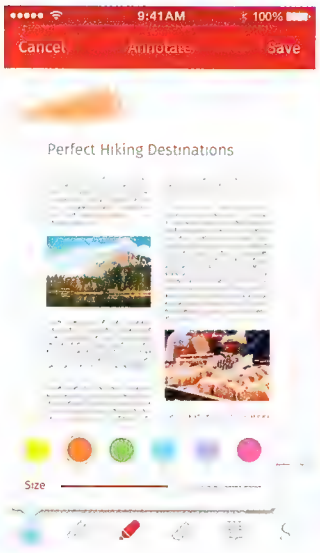
US$9.99 | BIT.LY/2FZJBQQ

With Siri for Mac only on macOS Sierra, if you're stuck on an older system, there's no Apple voice assistant for you. Quiri works with the Mac's native dictation functionality to perform most of Siri's tricks. With the click of a button or a "Hey, Quiri" command, the app can look up contacts, schedule appointments, play music, initiate FaceTime calls and more.

Quiri also responds to commands typically typed into Spotlight — say, current weather conditions, the score for last night's game or driving directions. It isn't as sleek or tightly integrated into macOS as Siri, but Quiri is equally responsive and more customisable, with light and dark modes, plus the ability to change text and button colours to suit your personal tastes.

However, there are a few limitations. You'll need to enable Enhanced Dictation (which can take up hundreds of megabytes on your startup disk), and Quiri auto-opens Contacts and iTunes,

which is required to command those apps. We discovered an issue where Quiri failed to work on Macs with a large media library (12,000 songs, in our case). The friendly, responsive developer did promise a fix, though, which should be available by the time you read this review. **JR Bookwalter**



Scanbot 6 Pro

Improved feature set for this scanning app.

FREE; $12.99 PRO VERSION | SCANBOT.IO

If you snap photos of documents and save them in the Camera Roll, Scanbot 6 is a revelation. The app provides a far slicker UI, plus a robust set of tools to capture, manage and share single or multi-page documents with ease. Automatic edge detection eliminates the need for manual cropping. The quality is fantastic and documents are saved in your choice of PDF or JPG files with a minimum resolution of 200dpi. The core app is free, with the ability to also scan QR or other barcodes, enhancements (filters, crop, rotate) and automatic upload to cloud services.

The Pro in-app upgrade is highly recommended. For starters, Scanbot 6 Pro automatically performs optical character recognition (OCR), which enables extracted text to be copied or searched. Smart file naming speeds up the process, along with WebDAV and FTP uploads, and the ability to add pages to existing scans. You can even capture documents and immediately send via text message, although the iMessage app lacks the full complement of editing features.

With version 6, Scanbot has also become a capable PDF editor. Users can now reorder, add, delete and rotate pages within documents, add encrypted password protection, or run OCR on imported documents created elsewhere. The built-in annotation features have likewise been overhauled with additional colours and tool sizes, although we do wish there was a way to import or sync existing signatures and sign on the iPhone in landscape mode, rather than scribbling on a narrow portrait display.

The biggest change in the latest version is relatively subtle — the interface has been refined and simplified, with a new emphasis on workflows that allow users to perform common tasks more quickly. If you frequently scan documents and immediately print or share them, Scanbot 6 streamlines this process considerably.

JR Bookwalter

Tinkerblocks

A bright, colourful coding app for kids.

$4.49 | URBNPOCKETS.COM

Every time a new coding app for kids gets released, we wonder if this will be the one to really get them engaged. TinkerBlocks looks the part, with its colorful, simple layout and tools to let kids build basic programs.

At first we thought we'd hit 'Info' to get acquainted, via a mini tutorial maybe. But no, this displays an adult-led description of the app. We also thought the thumbnails at the top were example programs, but they were IAPs (with a pretty weak maths question as security). There are basic starter projects: tap one to see the bare bones, or use the stylus icon to edit. You can add input/output controls, control features, an impressive set of sensors and a few effects. If the icons are not obvious, you can press one to find out what it does, then drag one over to the list of actions. It's easy to change order using drag-and-drop, and easy to delete an action by dragging it until the trash can appears.

We found the image tool a little frustrating. On our iPhone, the app couldn't access our Camera Roll despite having permission; then it could access it but reported "an issue" with every image. We experienced a similar working/not working issue with face detection.

There's definitely a learning curve to the app, and parents will almost definitely have to assist young 'developers'. Once comfortable with the concept, though, the results should keep your kids engaged. And it's easy for them to share their creations — maybe a bit too easy. As with the IAPs, the restriction is just a simple maths question. There's a lot to take in, but also a lot on offer once your little coders get the hang of things. **Jo Membery**

Adobe Photoshop Fix

Diddle with your pics while on the go.

FREE | WWW.ADOBE.COM/AU/PRODUCTS/FIX.HTML

There's a wide range of photo alteration options on offer here, giving you the ability to adjust facial features (enlarging eyes, pinching noses, stretching earlobes and so on), remove blemishes from skin, change hair colour, fiddle around with light and contrast, and also go nuts with the Healing category (which allows you to remove things from the environment, clone elements and also restore). The Clone Tool can't quite perform magic, but if you sink enough time into it, you can make an image look considerably better than before. While you've got a mode selected, it's impossible to move the image around or zoom, which is something we repeatedly forgot, meaning we'd accidentally paint a long line across our painting, then have to hit undo. Incorporating that feature would make this app a great deal more user-friendly. Of course, it's hard to be precise when you have a stubby finger instead of a graphics tablet and pen, so you won't be making any pieces of art here. But if you have to alter your images while on the go, this app is full of sliders to tweak and tools to try out — and you finish up on your computer if necessary, as the app automatically uploads your work to the cloud for easy downloading. **Carmel Sealey**

Android Auto

Turns your phone into a car-friendly voice-driven tool.

FREE | GOO.GL/MJLDZK

It's illegal to use your phone while driving a car, for obvious reasons: if you're looking at your phone instead of the road, you might crash into something. So it's lucky the benevolent overlords at Google have created this app which allows you to access some pretty important smartphone tools without having to look at it.

When you boot up the app, it'll request access to pretty much everything and then ask for a Bluetooth device to which it will pair automatically. It also creates a much larger version of Google Play Music so that you can navigate playlists at the briefest of glances. You don't have to look, though: voice recognition can be accessed with a single button press, allowing you to say "Play (music)", "Call (friend)" or "Navigate to (location)" instead. With my Australian accent, I didn't encounter any difficulties, though anyone familiar with Google's previous voice recognition outings will know it's a pretty reliable tool, so long as you temporarily weed the 'strewth's and 'dawg's from your vocab. A very useful app, overall. **Shaun Prescott**

PhotoScan by Google Photos

Scan photos with your phone.

FREE | WWW.GOOGLE.COM/PHOTOS/SCAN

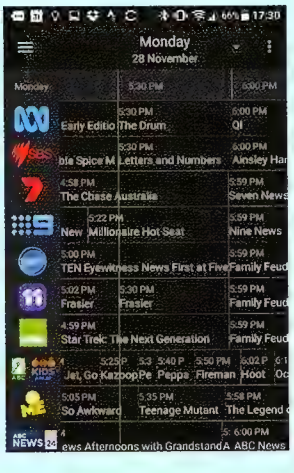
As the name implies, this new Google-developed app allows you to scan in your old photos using a smartphone camera. Simply open the app, hover your phone over the photo, follow the instructions (you need to align an AR circle over four dots in order for the app to do its magic) and then, theoretically, your photo is digitised. I tried it on a few different photos in a few different environments and the results were mixed. You're meant to be able to scan under any conditions, but glare remained in at least one attempt, despite Google's promise that it won't happen. But, you know, give the app a break, find a well-lit and non-glarry environment, and it works pretty well — they still look like old photos, but it's a step up from what they'd look like if you'd simply photographed them normally. A proper scanner is probably the better option, but hopefully Google will continue to finetune this app. **Shaun Prescott**

FreeView FV

Get Aussie catch-up TV on your mobile.

FREE | WWW.FREEVIEW.COM.AU

Between YouTube, Netflix, Stan and, at a pinch, Foxtel, it's a wonder that free-to-air television hasn't been completely shuttered under the sheer glut of original shows, wacky cat clips and top-shelf, Hollywood-quality productions that you can stream online. That's one view, or perhaps there's still something to reap from (or quietly comforting about) repeats of *M*A*S*H*. While all the terrestrial stations have their own apps that give you access to live TV, and also catch-up services, they're separate. FreeView ties them all under the one banner and operates like a traditional menu, giving you the channels that are most suitable to your location. Scroll through, pick your channel, and away you go. However, you can't jump into catch-up TV, nor can you record shows for later — this is purely for watching shows as they happen. The app offers a few choices for the bit rate so you don't destroy your data allowance, and the EPG is nice and clear with the option to set reminders for your favourite shows. **Paul Taylor**



Krusader

A useful file manager.

FREE | KRUSADER.ORG

The twin-panel style of file manager doesn't appear to be disappearing anytime soon, and this is certainly true for Krusader. Version 2.5 is a shiny new release of the manager after more than four years of development, which has included implementing many new features and porting the application to Qt5 and KF5 libraries.

Krusader reveals the depth of its built-in features when you start using it in everyday life. The most notable are built-in archive support, remote connectivity (SFTP and Samba), a disk usage statistic pie chart, an internal viewer and editor for file types, a batch renaming tool, a search module and checksum calculator. Krusader works like a Swiss Army knife for those who would love to do everything without switching windows.

The application's graphical interface should be familiar to everyone who's used Midnight Commander in Linux, Total Commander in Windows and maybe even Norton Commander in DOS before. There are two panels that can display any directories so that you can copy, move and delete files between the source and destination. Krusader's bottom bar also stores shortcuts for common actions, such as F5 for copying, F6 for moving and F3 for viewing.

The first time that the app launches, it performs a one-time check for external applications – the more it detects, the more feature-packed it will be. If an app is missing, Krusader will still work, but you will find that the respective feature will be disabled.

As Krusader is KDE-centric, you'll need to get ready to install some KDE-related extra utilities, such as Filelight and Kate to make Krusader more powerful. However, you can always change your preferences in the Dependencies section of Krusader's section. So Krusader can nicely integrate with standard Gnome-related utilities, once you specify them manually. **Alexander Tolstoy**

Neural Enhance

A not-quite-CSI image enhancer.

FREE | BIT.LY/NEURALENHANCE

We already know how to imitate a Hollywood technodrama in Linux using Ubuntu's "Hollywood package", but what if some magic from secret CSI labs could become real and we could, for example, enhance still shots from CCTV cameras in order to read numbers on car plates? Well, we're getting a little closer to it thanks to Neural Enhance.

There seems to be a growing trend of open-source algorithms that use neural networks to enhance pictures. We surfed GitHub and found many similar projects, but Neural Enhance is the most noteworthy. It's also quite simple to set up.

The idea behind Neural Enhance is trivial: although a low-resolution image can't be enriched with more real details, we can reconstruct and suggest such details using a data model, which is based on other images. As a result, it becomes possible to upscale an image with greater quality than with convenient methods (such as 'Image > Resize in GIMP'). The quality of the output is very dependent on such a model. But Neural Enhance is quite friendly to beginners and offers a viable test model by default. Installing the whole thing can be complicated for non-tech-savvy Linux users, but luckily the author offers a quicker way by using Docker. If you want to discover the possibilities of the algorithm manually, just install Docker for your distribution (distro) and then run the Neural Enhance image:

```
$ docker run alexjc/neural-enhance /bin/bash
```

A more practical way is to create an alias that automatically pulls the proper image and passes the command:

```
$ alias enhance='function ne() { docker run --rm -v "$(pwd)/`dirname ${@:$#}`":/ne/input -it alexjc/neural-enhance ${@:1:-1} "input/`basename ${@:$#}`"; }; ne'
```

Then upscale your image with:

```
$ enhance --zoom=2 --model=small images/example.jpg
```

Use a different value for the `--zoom` option to adjust the scale factor.

Alexander Tolstoy

CRUSH WINDOWS 10 ANNOYANCES

BANISH THE BUILT-IN ADS, STOP IT FROM SPYING & REPLACE DUD APPS WITH BETTER FREE OPTIONS

48 **CRUSH WINDOWS 10 ANNOYANCES**
We've catalogued some of our biggest beefs with Windows and how you can fix them.

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Microsoft has been getting more aggressive about pestering us with ads. Here's what you can do to make it stop.

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Stop your Windows PC taking note of your every move.

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Microsoft doesn't make it easy, so let us guide you through the various methods to stop your PC from rebooting itself.

57 **CREATE THE ULTIMATE WINDOWS REPAIR DISC**
Turn panic into minor irritation by crafting your own customised recovery disc or USB drive.

Crush Windows 10 annoyances

We've catalogued some of our biggest beefs with Windows 10 and how you can fix them. Nathan Taylor reveals all.

Are there things about Windows that still bug you? Is it launching the wrong apps, harassing you with notifications, starting apps you don't want or showing interface elements you'd rather have hidden? Then this is the guide you've been looking for.

LOSE THE NOTIFICATIONS

Let's start with the low-hanging fruit of Windows annoyances: notifications. Certain apps and Windows features just love to send completely pointless notifications, constantly bothering us with things we don't care about or 'reminders' to do things we don't actually want to do.

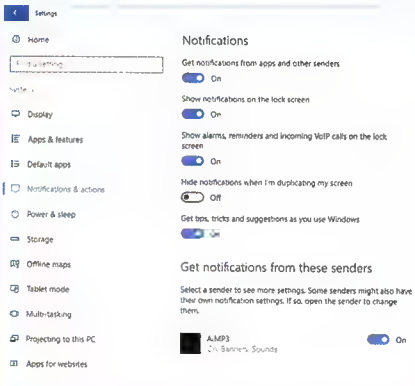
This is an easy fix. When you get a notification from an app or service you don't want notifications from, just right click on it in the Action Centre and select the option to disable notifications for this group. Easy.

You can manage Notifications globally from the Windows Settings under 'System > Notifications & Actions'. Here, you can manually switch on or off Notifications from individual apps. You can also disable lock screen notifications as well as Windows tips and tricks.

CLEAR PRE-INSTALLED APPS

Okay, this one's not on Microsoft. It's on the OEMs that load their new PCs with unnecessary crapware, like security suite and online storage trials, support utilities and apps that are already covered in the Windows default set. To get rid of all this stuff, we recommend an app called Decrap My Computer (**decrap.org**). Decrap functions as a mass-uninstaller, allowing you to view all your installed apps, check the boxes next to the ones you don't want, and then let it remove them from your computer. You do have to be a little careful, and we don't recommend running it in automatic mode, but if you want to get rid of a lot of stuff quickly, it's great.

An alternative tool is PC Decrapifier (**www.pcdecrapifier.com**), a similar app that uses group intelligence to recommend apps to remove. For instance, if 95% of other PC Decrapifier users removed a given app, it will recommend you uninstall it as well.



Turning off Notification features can really spare you annoyance.

FIX FILE ASSOCIATIONS

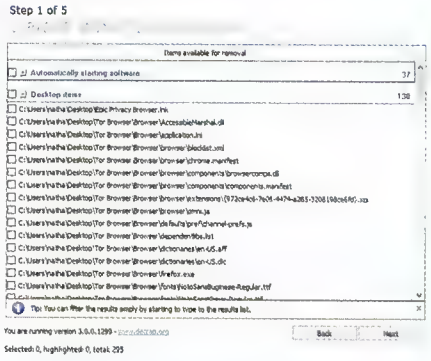
File associations are a constant source of annoyance, especially when a file is associated with the wrong app. For instance, if you prefer VLC but it keeps using Windows Media Player whenever you click on an AVI file, it's going to get old quickly.

The way to fix associations is not terribly intuitive. In File Explorer, right click on any file of the type you want to change the association with. Select 'Open with > Choose another app'. Do this even if the app you want to associate to that file type is listed in the available options. (If you choose the app from that list, then it will just use it this one time. We want to change the association permanently.)

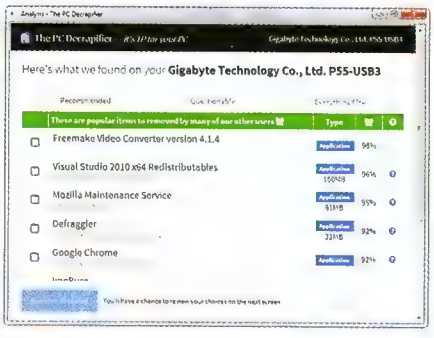
Now, find the app you want to associate with the file type. If it's not listed you may have to click on 'Look for another app on this PC'. Check the box to associate that file type with that app permanently.

The other way you can manage file associations is through Settings. It's under 'Settings > System > Default apps'. You'll have to scroll down and click on Choose default applications by file type. This will list all the file types Windows has encountered so far and their associated apps.

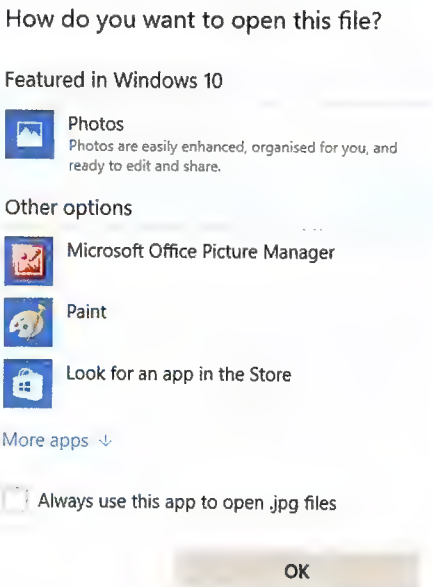
Click on the name of an app next to the file type (or the '+' button if no app



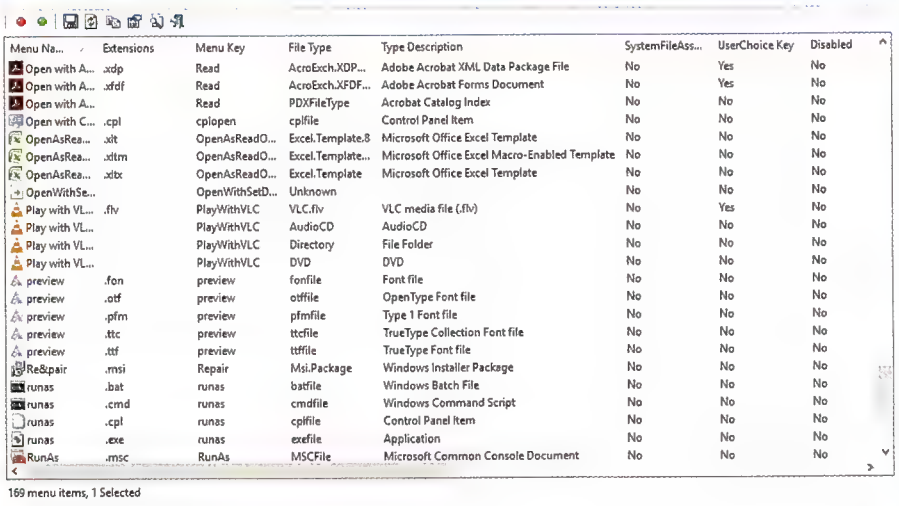
Decrap My Computer quick uninstalls junk you don't want.


The PC Decrapifier
Here's what we found on your Gigabyte Technology Co., Ltd. P55-USB3
Freemake Video Converter version 4.1.4
Visual Studio 2010 x64 Redistributables
Mozilla Maintenance Service
Defraggler
Google Chrome

PC Decrapifier makes recommendations based on other users' choices.


How do you want to open this file?
Featured in Windows 10
Photos
Photos are easily enhanced, organised for you, and ready to edit and share.
Other options
Microsoft Office Picture Manager
Paint
Look for an app in the Store
More apps
Always use this app to open .jpg files
OK

Use 'Open with > Choose another app' to set associations.



Menu Na...	Extensions	Menu Key	File Type	Type Description	SystemFileAss...	UserChoice Key	Disabled
Open with A...	.xdp	Read	AcroExch.XDP...	Adobe Acrobat XML Data Package File	No	Yes	No
Open with A...	.xfdf	Read	AcroExch.XFDF...	Adobe Acrobat Forms Document	No	Yes	No
Open with A...		Read	PDXFileType	Acrobat Catalog Index	No	No	No
Open with C...	.cpl	cplopen	cplfile	Control Panel Item	No	No	No
OpenAsRea...	.xlt	OpenAsReadO...	Excel.Template.8	Microsoft Office Excel Template	No	No	No
OpenAsRea...	.xltm	OpenAsReadO...	Excel.Template...	Microsoft Office Excel Macro-Enabled Template	No	No	No
OpenAsRea...	.xltx	OpenAsReadO...	Excel.Template	Microsoft Office Excel Template	No	No	No
OpenWithSe...		OpenWithSetD...	Unknown		No	No	No
Play with VL...	.flv	PlayWithVLC	VLC.flv	VLC media file (.flv)	No	Yes	No
Play with VL...		PlayWithVLC	AudioCD	AudioCD	No	No	No
Play with VL...		PlayWithVLC	Directory	File Folder	No	No	No
Play with VL...		PlayWithVLC	DVD	DVD	No	No	No
preview	.fon	preview	fonfile	Font file	No	No	No
preview	.otf	preview	otffile	OpenType Font file	No	No	No
preview	.pfm	preview	pfmfile	Type 1 Font file	No	No	No
preview	.ttc	preview	ttcfile	TrueType Collection Font file	No	No	No
preview	.ttf	preview	ttffile	TrueType Font file	No	No	No
Re&pair	.msi	Repair	Msi.Package	Windows Installer Package	No	No	No
runas	.bat	runas	batfile	Windows Batch File	No	No	No
runas	.cmd	runas	cmdfile	Windows Command Script	No	No	No
runas	.cpl	runas	cplfile	Control Panel Item	No	No	No
runas	.exe	runas	exefile	Application	No	No	No
RunAs	.msc	RunAs	MSCFile	Microsoft Common Console Document	No	No	No

169 menu items, 1 Selected

Click on an item, then click on disable.

has been chosen) to change the app associated with it. Note that Windows doesn't display the updated app immediately – you have to leave this menu and go back to see the changes.

CLEARING UP YOUR CONTEXT MENU

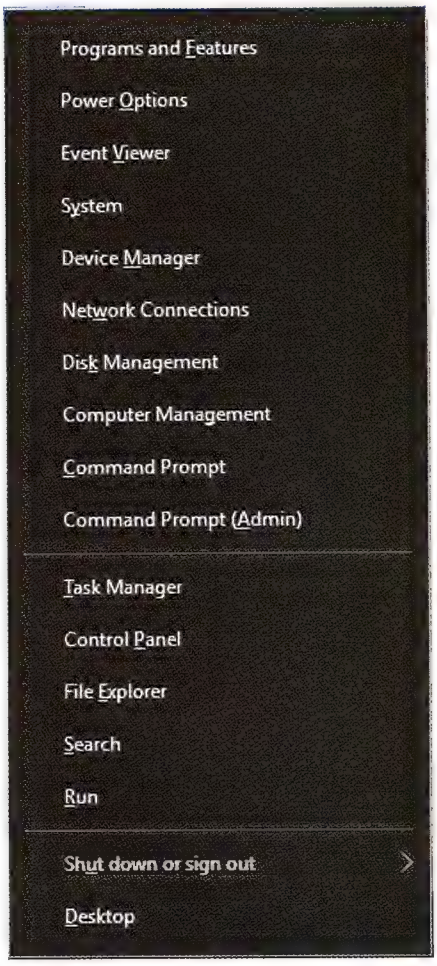
Once you've installed a few things, your File Explorer context menu can get a little crowded. If you'd like to trim it down to a reasonable level again, then the best way is to use a couple of utilities from NirSoft: ShellMenuView and ShellExView, both available at **www.nirsoft.net**. Respectively, these disable shell menu items and shell extensions (a menu item is a static addition to the menu and an extension is a contextual app-based option, like having Winzip options appear when you right click a Zip file; from a user standpoint they're very similar).

Just install one or both apps and run them. ShellMenuView is the main one, and will likely cover the most options.

From the interface, just find the context menu options you'd like to disable and select them. You can control- or shift-select more than one item. Then press the red disable button to remove the ones you want gone.

ACCESS SETTINGS AND COMMAND PROMPTS OLD-SCHOOL STYLE

Speaking of old school, there's one hot key that every long-time Windows power user should know: 'Win-X', which does the same thing as right clicking on the start button. It's the quick way to get to those tools that you're always having to search through the new control panel to find. Want to quickly access network adapter settings without having to go through the Network & Sharing Centre? What about the device manager or storage administration console without having to delve through the System menu? The power options, command prompt, task manager event view and even old-style control panel are all here as well.



The 'Windows key + X' menu is a godsend for quickly accessing common settings without having to navigate through the new Settings menu.

You can also configure the 'Win-X' menu to show the PowerShell in lieu of the command prompt. Go to 'Settings > Personalisation - Taskbar' and enable the option to replace the command prompt with the PowerShell.

Tweak your Start menu to be less intrusive

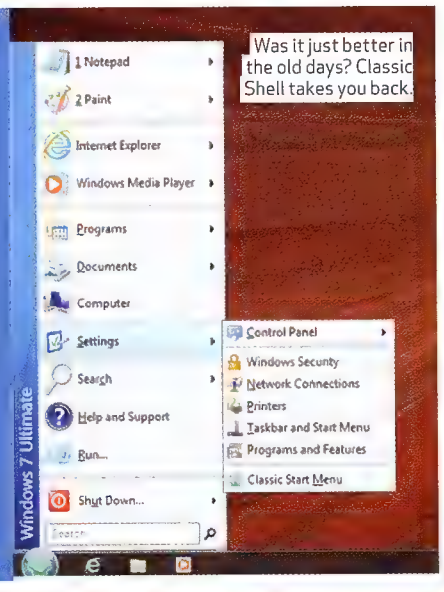
There are lots of little things you can do to your start menu to make it less annoying to you. You can try to:

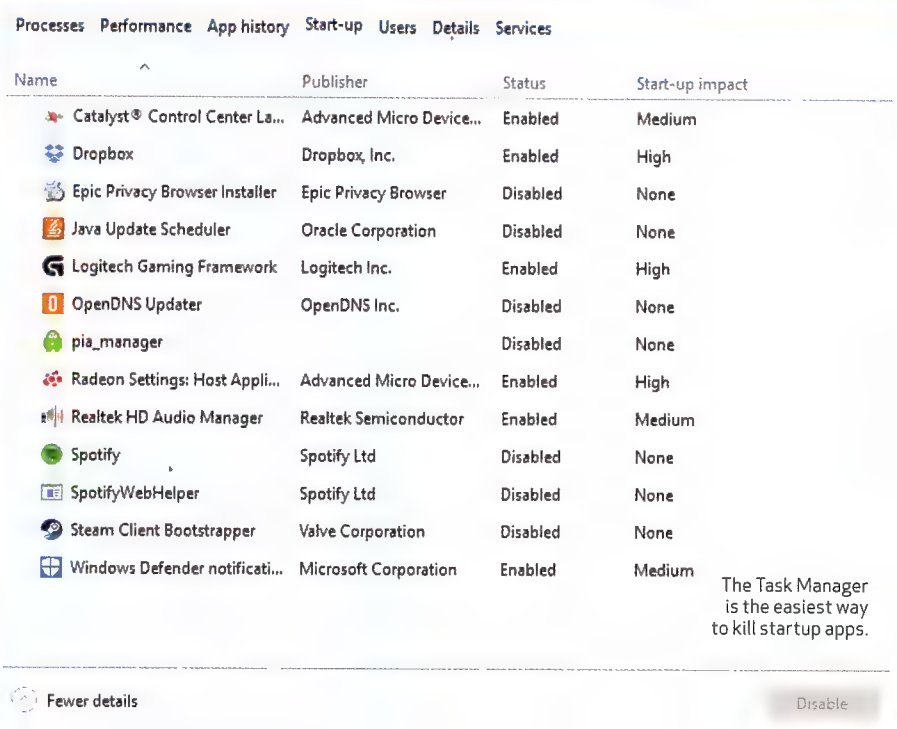
Change its width and height, so you can see more icons without scrolling, or alternatively see more of your screen when it's present. If you hover your mouse over the right hand or top side of the Start menu when it appears, you'll see a resize tool. You can drag it up or down, left or right, to change the size of the menu. The tiles will adjust to the new size.

Turn Live tiles into static tiles. Just right click on a Live tile and select 'More > Turn live tile off'.

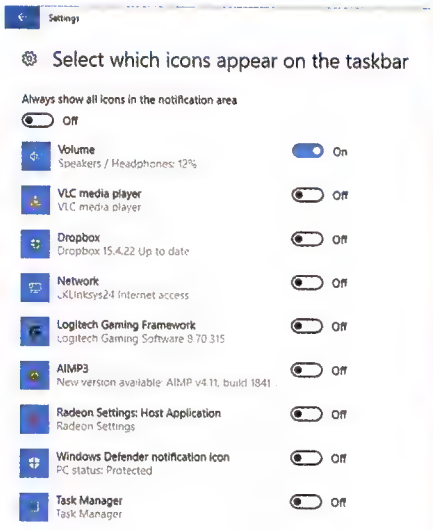
Resize tiles. They can go quite small, down to icon size (with no text) and depending on the app, can go as large as 4x4. Just right click on a tile and select 'Resize'.

Go retro with Classic Shell (**www.classicshell.net**), which gives you the option to go with Windows 7-style or even older-style menus. It also changes File Explorer to be like the old Windows Explorer.




Processes Performance App history Start-up Users Details Services
Name Publisher Status Start-up impact
Catalyst® Control Center La... Advanced Micro Device... Enabled Medium
Dropbox Dropbox, Inc. Enabled High
Epic Privacy Browser Installer Epic Privacy Browser Disabled None
Java Update Scheduler Oracle Corporation Disabled None
Logitech Gaming Framework Logitech Inc. Enabled High
OpenDNS Updater OpenDNS Inc. Disabled None
pia_manager Disabled None
Radeon Settings: Host Appli... Advanced Micro Device... Enabled High
Realtek HD Audio Manager Realtek Semiconductor Enabled Medium
Spotify Spotify Ltd Disabled None
SpotifyWebHelper Spotify Ltd Disabled None
Steam Client Bootstrapper Valve Corporation Disabled None
Windows Defender notificati... Microsoft Corporation Enabled Medium
Fewer details
Disable

The Task Manager is the easiest way to kill startup apps.



Turn icons off to keep your Taskbar clear of clutter.

MANAGE STARTUP APPS

One of the best new features of recent versions of Task Manager is the ability to control what starts when your computer does, making it easy to prevent annoying apps from starting before you need them to. Press 'Win-X', then select Task Manager.

Click on the Start-up tab to see the apps that start when Windows does. You can disable them by clicking on one and then on 'disable'.

If you like doing things hardcore, you can also use regedit (see below). The relevant entry is:

HKEY_CURRENT_USER\SOFTWARE\Microsoft\Windows\CurrentVersion\Explorer\StartupApproved\Run

...for the current user. For all users, go to:

HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\Explorer\StartupApproved\Run

Find the app you don't want starting and right click on it, then 'Delete'.

Finally, there's the old timey Startup folder, a relic from the Windows 95 days. Any app or link placed in this folder will start when Windows does. Not many apps now use it, but some might. To see what's in your Startup folder, press 'Win-R' to bring up the run dialog. Type `shell:Startup` into the field, which will bring up your Startup folder.

DISABLE THE STICKY KEYS KEY

Sticky keys is an accessibility option for people who have problems pressing more than one key at a time. It's disabled by default. To enable or disable sticky keys, one would normally press the shift key five times in succession, which will make the sticky keys popup appear.

The problem for gamers is that they might actually press the shift key five times as part of playing the game, which will immediately interrupt their game and probably cause a loss. Thankfully, you can make sure the sticky key popup no longer appears. Just press shift five times to bring up the window. There's a link right there to go to ease of access to disable the shortcut. Best to do this before you start playing.

GET RID OF (OR RE-ENABLE) TASKBAR ICONS

So the Taskbar icons are really stacking up, taking up a lot of the available space on your screen. Thankfully, you can trim that down in the settings menu, with icons that you don't use or need to see continuously relegated to a drawer.

You'll find what you need in 'Settings > Personalisation > Taskbar'. Here, you can make the Taskbar thinner or auto hide it. When it comes to icons, scroll down to Notification area and click on 'Select which icons appear on the taskbar'. A list of apps that have tried to shove an icon there are listed; and those you switch to 'off' will be relegated to the icon drawer, which appear next to the icons on the bottom right (it looks like an up arrow – ^).

You can also go back to the Taskbar settings and click on 'Turn system icons on or off'. This way, you can dump things like the network and power indicators and even the Action Centre.

STOP WINDOWS FROM ASKING PERMISSION TO CHANGE SETTINGS

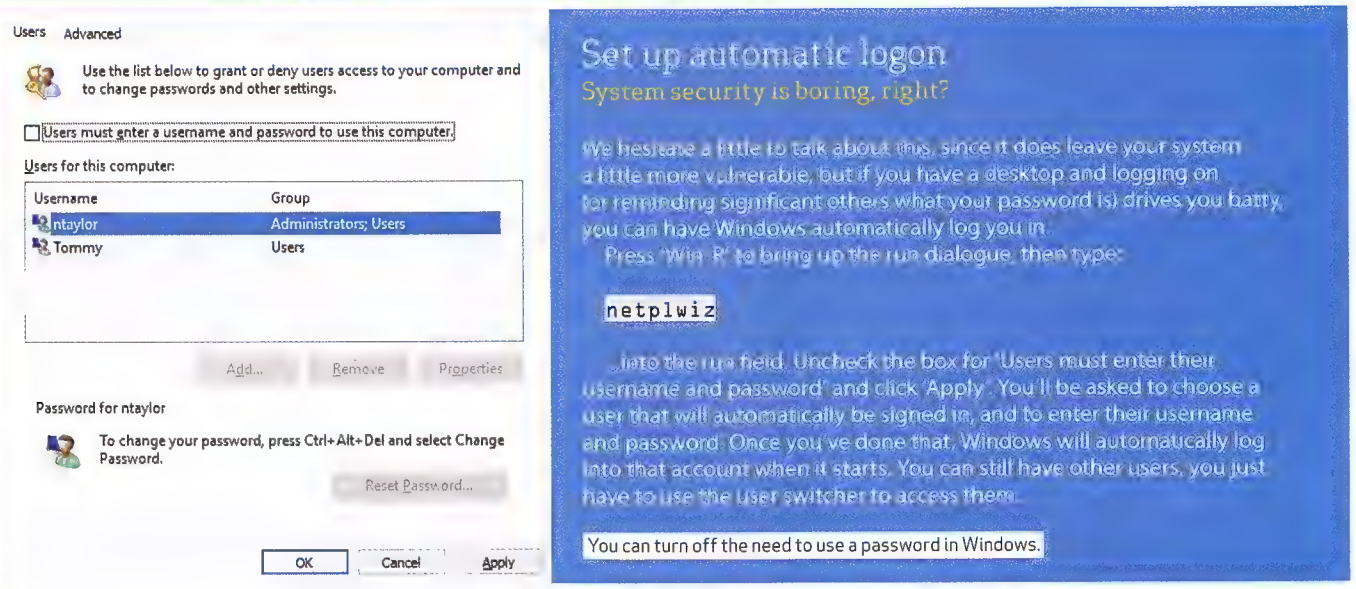
That popup you get, asking for your permission to change a Windows system setting or install an app – have you ever said no? If you're tired of your PC asking, you can turn this off. It's called User Account Control, and we should warn you: it exists for a reason. It's so apps can't make unauthorised changes to certain Windows settings without your permission. But if you're careful

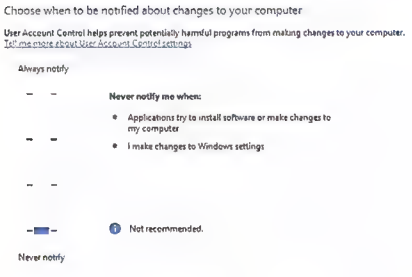
Regedit

The good old registry editor is still there in Windows 10, for those that are brave enough to edit it.

The Registry contains all the 'core' settings for Windows, and in it, you can access even fine configuration details for which there is no configuration menu.

Unless you're an old hand at registry editing, we'd advise approaching it with caution. You can really mess up your system if you don't know what you're doing.


Users
Advanced
Use the list below to grant or deny users access to your computer and to change passwords and other settings.
Users must enter a username and password to use this computer.
Users for this computer:
Username
Group
ntaylor
Administrators; Users
Tommy
Users
Add...
Remove
Properties
Password for ntaylor
To change your password, press Ctrl+Alt+Del and select Change Password.
Reset Password...
OK
Cancel
Apply
Set up automatic logon
System security is boring, right?
We hesitate a little to talk about this, since it does leave your system a little more vulnerable, but if you have a desktop and logging on (or reminding significant others what your password is) drives you batty, you can have Windows automatically log you in.
Press 'Win-R' to bring up the run dialogue, then type:
netplwiz
into the run field. Uncheck the box for 'Users must enter their username and password' and click 'Apply'. You'll be asked to choose a user that will automatically be signed in, and to enter their username and password. Once you've done that, Windows will automatically log into that account when it starts. You can still have other users, you just have to use the user switcher to access them.
You can turn off the need to use a password in Windows.


Choose when to be notified about changes to your computer
User Account Control helps prevent potentially harmful programs from making changes to your computer.
Tell me more about User Account Control settings
Always notify
Never notify me when:
Applications try to install software or make changes to my computer
I make changes to Windows settings
Not recommended.
Never notify

Turn UAC off to stop Windows asking for permission to do stuff.

about what you install, you can turn it off fairly easily.

Press 'Win-X' and then select Control Panel to get to the old-style control panel. Go to 'User Accounts > User Accounts > Change User account Control settings'. (Alternatively, type "UAC" into the search bar for quicker access). Drag the bar down to 'Never notify' to turn UAC off.

HIDE THE SEARCH BAR

Windows' search/Cortana function is actually invaluable, but it sure does take up a lot of room on the Taskbar. You can easily reclaim that space, however, without losing out on any of the search functionality.

To get rid of the search bar, right click anywhere on any unused part of the Taskbar, then look for either Cortana (if it's enabled) or Search in the context menu. Hover your mouse over it, then select 'Hidden'.

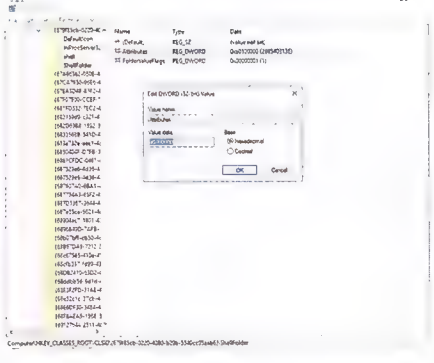
To access Windows' search function from now on, all you have to do is press the Windows key on your keyboard (which will bring up the Start menu) and start typing in your search terms. As soon as you start typing anything, the search box will open.

NEUTER OR GET RID OF QUICK ACCESS

We're sure plenty of people find the Quick Access menu in File Explorer useful. We find it a waste of space and an extra click we have to deal with whenever we start it up.

Now the easy way to deal with it is to neuter its functionality. In File Explorer, click on 'View' at the top of the window, then on 'Options' to bring up Folder Options. Change the field 'Open File Explorer to:' to 'This PC' in the drop down menu. Then uncheck the two boxes under privacy. Once you've OK'd that, Quick Access will still be there in File Explorer, but it will be empty and won't be the default folder when you open File Explorer.

Once you've done this, you can now even use the Quick Access menu like the old Favourites menu. Right click on a folder and select 'Pin to Quick Access', and a link will be created under Quick Access. You can right click on the folder name again to unpin it.



You can just use the folder settings to neuter it.

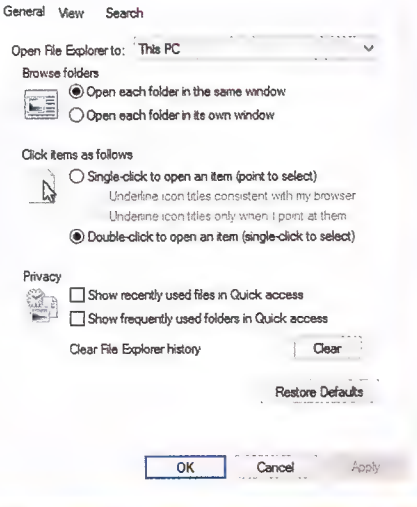
Really killing Quick Access involves some registry shenanigans.

If you want to get rid of Quick Access altogether, it's possible, but not easy (and probably not worth it, unless you really hate Quick Access). You first have to change the 'Open File Explorer to:' field as above, or you will get an error. Then you have to open regedit (see opposite) and navigate to the entry:

HKEY_CLASSES_ROOT\CLSID{679f85cb-0220-4080-b29b-5540cc05aab6}

Right click on the sub menu 'ShellFolder' and select 'Permissions'. Click on 'Advanced', then on the link to 'Change the owner of the folder'. Click on 'Advanced' again, then on the 'Find now' button and select 'Administrators'. Now that the folder is owned by Administrator (that's you) keep clicking on OK/Apply until you get back to Regedit.

Finally, you can now right click on 'Attributes' in ShellFolder, select 'Modify' and change the value from a0100000 to a0600000. Restart Windows and Quick Access should be gone.



Banish Microsoft's built-in ads

Windows 10 users will no doubt have noticed that Microsoft has been getting more aggressive about pestering us with ads. Nathan Taylor shows what you can do to make it stop.

DISABLING THE LOCK SCREEN ADS

Thanks to Windows Spotlight's lock screen 'experience', we now get ads on our lock screens shuffled in amidst the photos.

You can turn this off easily enough, although you'll no longer get the Spotlight wallpapers. Head to 'Settings > Personalisation > Lock Screen'. Change the background from 'Windows spotlight' to either picture or slideshow.

'NO' TO THE 'GET OFFICE'

If you're not running the very latest version of Office, Windows 10 will pester you to do so, throwing up notifications constantly. You can shut these down in a couple of ways.

The easiest is to right click on a notification when you get one and choose the option to disable notifications for that app (you can also go to 'Settings > System > Notifications & Actions' and turn it off there).

You can also just uninstall Get Office – just right click on it in the Start Menu and choose Uninstall – though there's no guarantee that Microsoft won't throw it back on in an update.

While you're at it, you can do the same with the other 'Microsoft Consumer Experience' apps that get installed on your system without your asking, like *Minecraft*, Flipboard and Twitter.

STOP SUGGESTED APPS

Microsoft sometimes likes to suggest apps for you in the Start menu – by which it means to advertise the hell out of things available in the Windows Store. This is another relatively easy fix. Just head to 'Settings > Personalisation > Start'. There's a switch there for 'Occasionally show suggestions in Start' that you can turn to 'off'.

FINDING A BETTER SOLITAIRE

One of the cheesiest things Microsoft did in Windows 10 is add a subscription for its *Solitaire* games. A subscription. For *Solitaire*. Now to play a game that we enjoyed for free up until Windows 7, you have to pay an annual fee or put up with endless ads. Nope – we're going to find something better.

There are actually a number of free, no-ad versions of *Solitaire* available. For classic *Klondike Solitaire*, you can just type "Solitaire" into a Google search – Google has a special little Javascript version of it that pops up. You can also head to **solitaireforfree.com** for a full-window version.

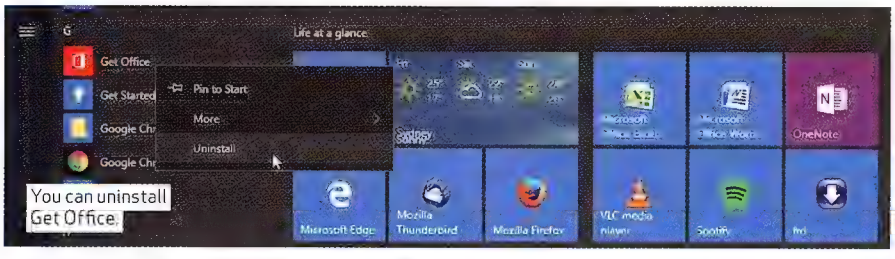
For *Spider* and *Freecell*, we recommend a couple of Chrome apps available from **spacekidgames.com** and the Chrome Web Store. They're fast and ad-free. For *Minesweeper*, try **minesweeperforfree.com**.

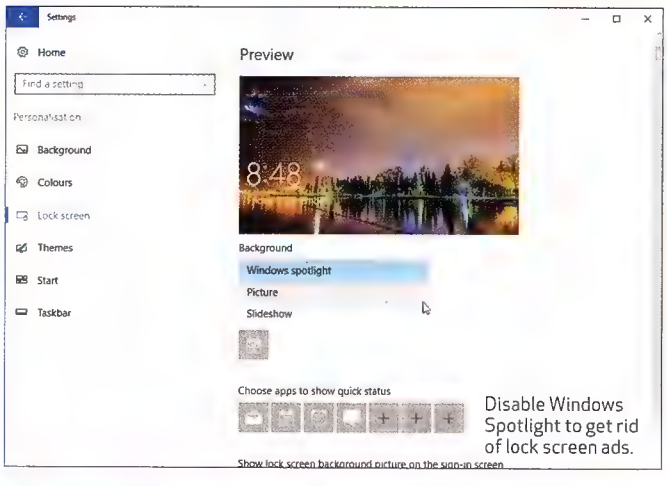
If you really want to use Microsoft's app ad-free (without a sub), you can modify your PC's hosts file so that it can't contact Microsoft's ad server. The popups will still be there, but they will be blank. To do this, open Notepad as a system administrator and follow these steps:

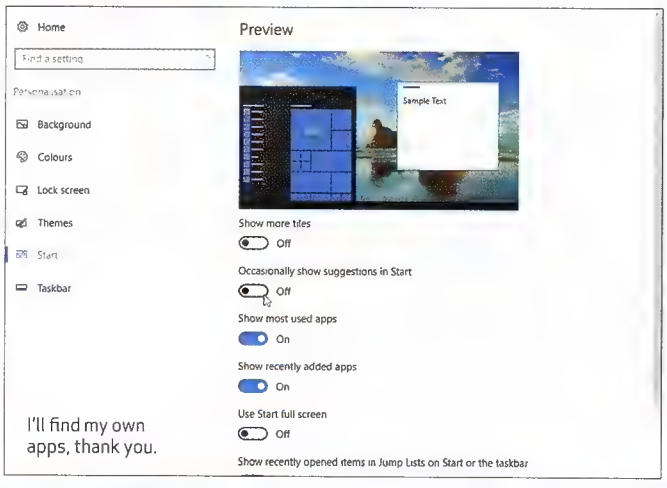
- In Notepad, open the file C:\windows\system32\drivers\etc\hosts (with no extension)
- Add a single line at the end of it:
  `127.0.0.1 mobileads.msn.com`
- Save the file with Ctrl-S. (If you use the save dialogue, Notepad might append a '.txt' to the file, which we don't want).

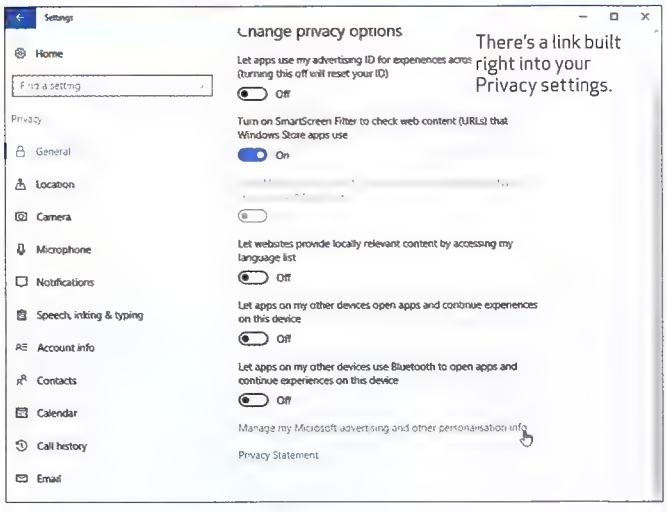
DISABLE LIVE TILES

Sometimes live tiles in the Start Bar

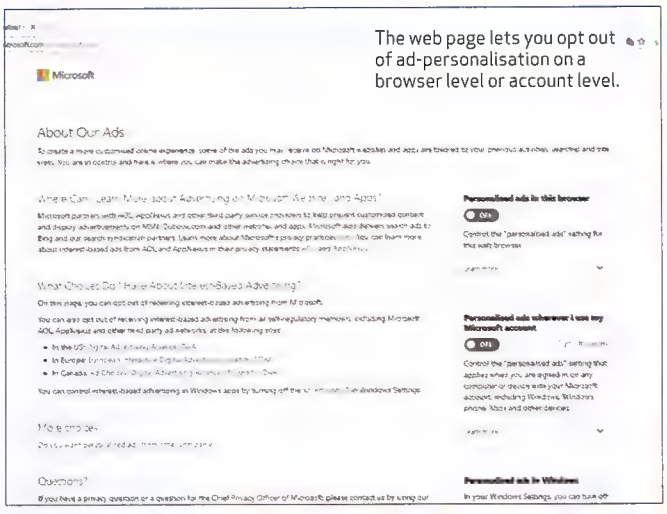




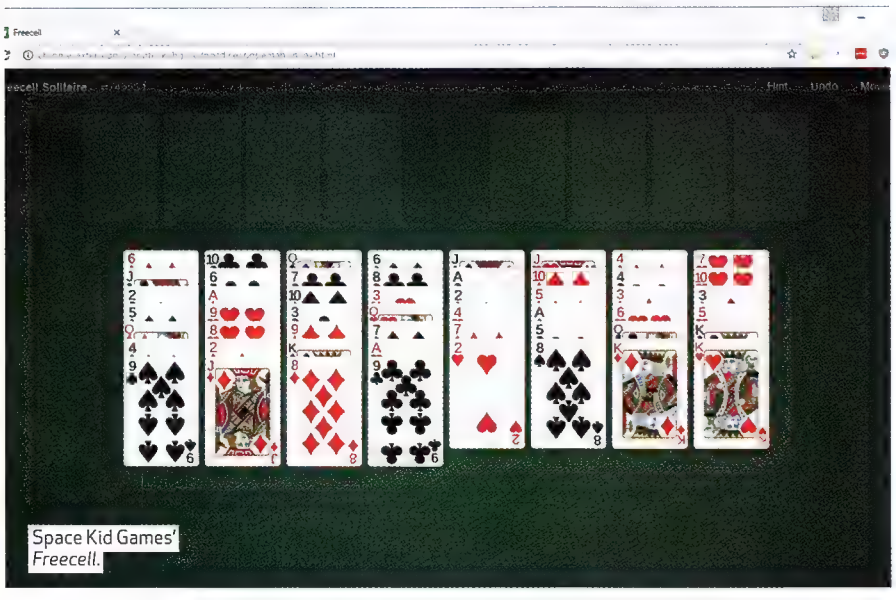



Settings
Change privacy options
Let apps use my advertising ID for experiences across (turning this off will reset your ID)
Off
Turn on SmartScreen Filter to check web content (URLs) that Windows Store apps use
On
Let websites provide locally relevant content by accessing my language list
Off
Let apps on my other devices open apps and continue experiences on this device
Off
Let apps on my other devices use Bluetooth to open apps and continue experiences on this device
Off
Manage my Microsoft advertising and other personalisation info
Privacy Statement
Home
Find a setting
Privacy
General
Location
Camera
Microphone
Notifications
Speech, inking & typing
Account info
Contacts
Calendar
Call history
Email

There's a link built right into your Privacy settings.



The web page lets you opt out of ad-personalisation on a browser level or account level.



Space Kid Games' *Freecell*.

are used for advertising, with software makers using their little Start bar box to show a rotating display of recommendations and upsells. Thankfully, you can turn live tiles off.

Just right click on any live tile that's annoying you and select 'More > Turn live tile off'. That will turn the tile into a static one.

MANAGE AD PERSONALISATION FROM MICROSOFT

Microsoft is (surprisingly) still well behind Google when it comes to managing your account history and choosing what data is gathered, but it does have some options for managing the kinds of ads it throws at you. You can't, of course, turn Bing/Cortana search result ads off, but you can turn off their personalisation and some of the data gathering.

Head to 'Settings > Privacy > General' and click on the link to 'Manage my Microsoft advertsising and other personalisation info'. It will open your browser to a web page (**choice.microsoft.com/en-GB/opt-out**) where you can control some of the settings.

Here, you can switch off personalised ads in this browser (which creates a cookie for the browser that notifies Microsoft sites to no longer deliver personalised ads) as well as for your Microsoft account. The latter disables ad personalisation whenever you're logged into your Microsoft account on any device.

There's one more thing to do, which is to stop third-party apps from using your Microsoft browsing and search history to personalise ads. If you haven't done so already as part of the 'Stop Windows 10 Spying' section of our superguide (see page 54), you can turn off the option to let third-party apps personalise ads based on your Microsoft profile. Head to 'Settings > Privacy' and switch the first option to 'off'.

The ad-blocker

Blocking ads that appear in a Web browser has been pretty easy for some time. We currently recommend uBlock Origin, an add-on available for Chrome, Firefox and Safari. (Adblock Plus still works, but some of its recent business moves have made us less confident about recommending it).

You can also implement a more global ad-blocking regime if you're willing to set it up. This will work for all downloaded ads, no matter whether they're embedded in applications or in a browser, it should block them all.

In the section/rant on *Solitaire* opposite, we talked about the 'hosts file. This is a file on your computer that essentially overrides normal DNS lookup rules. In the *Solitaire* example, we made **mobileads.msn.com** point to 127.0.0.1 (the localhost), essentially making it point at nothing. So when a Microsoft app goes to mobileads.msn.com to grab ads, it won't find anything.

There are community created hosts files online that you can actually grab and put on your system if you want to. These can contain a comprehensive list of ad sites. A good place to start is hpHosts (**www.hosts-file.net**), where you can download the latest community created anti-ad hosts file. Just download it and copy it over the file: **C:\windows\system32\drivers\etc\hosts**

You may want to make a backup of your current hosts file first, though the default Windows hosts file is pretty much empty.

Stop Windows 10 spying

Nathan Taylor is here to help you stop your Windows PC taking note of your every move.

More than any version of Windows before it, Windows 10 is built to Hoover up massive amounts of information about your activity and send it back to Microsoft. Microsoft, of course, claims that this is benign, used to enhance your experience with the operating system. And to be fair, it's no more than Google and Apple do. But if you're not comfortable with your desktop OS gathering information about you, there are measures you can take.

PRIVACY OPTIONS

The obvious place to start is in the Privacy section of Windows 10's settings. In the 'General' tab, you can just switch everything to off. The one option we might recommend leaving on is the SmartScreen Filter for apps, which filters malicious URLs visited by Windows Store apps the way that Internet Explorer does. This means that you can't visit a malicious website in any app using the new WinRT runtime (which is the new core application architecture introduced in Windows 8 and used in most Windows Store apps).

FEEDBACK & DIAGNOSTICS

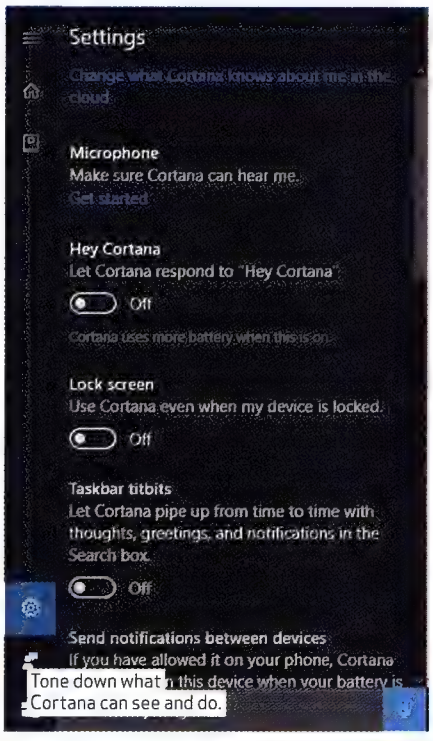
While you're in the Privacy settings, you'll see a section called 'Feedback & diagnostics' where you can control the amount of times Windows 10 asks for your feedback or how much information it gathers and sends back to Microsoft for resolving system issues.

This is something of a problem point in Windows, since there's no easy way to turn it off completely. You can turn off feedback (and should, if you don't want to be annoyed by popup questions), but the best you can do is set 'Diagnostic and usage data' to 'Basic'.

Even on Basic, when an app crashes or Microsoft requests diagnostic data, it will still send your full system specs, programs run, the device's IP address and other network information. And that's the minimum setting.

The best way to combat this is to disable the system services that send data back to Microsoft.

Press Windows-R and type `services.msc` into the Run box. Look for 'Connected User Experiences


Settings
Change what Cortana knows about me in the cloud
Microphone
Make sure Cortana can hear me.
Get started
Hey Cortana
Let Cortana respond to "Hey Cortana"
Off
Cortana uses more battery when this is on.
Lock screen
Use Cortana even when my device is locked.
Off
Taskbar titbits
Let Cortana pipe up from time to time with thoughts, greetings, and notifications in the Search box.
Off
Send notifications between devices
If you have allowed it on your phone, Cortana
Tone down what this device when your battery is
Cortana can see and do.

For Windows 10 Enterprise

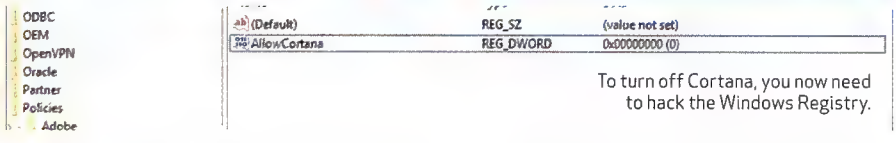
There is a widely circulated trick for turning off diagnostics, but you should know that this will only work for Windows 10 Enterprise (where you can turn it off in the Group Policy Editor, anyways).

The trick involves opening regedit and finding the registry key:

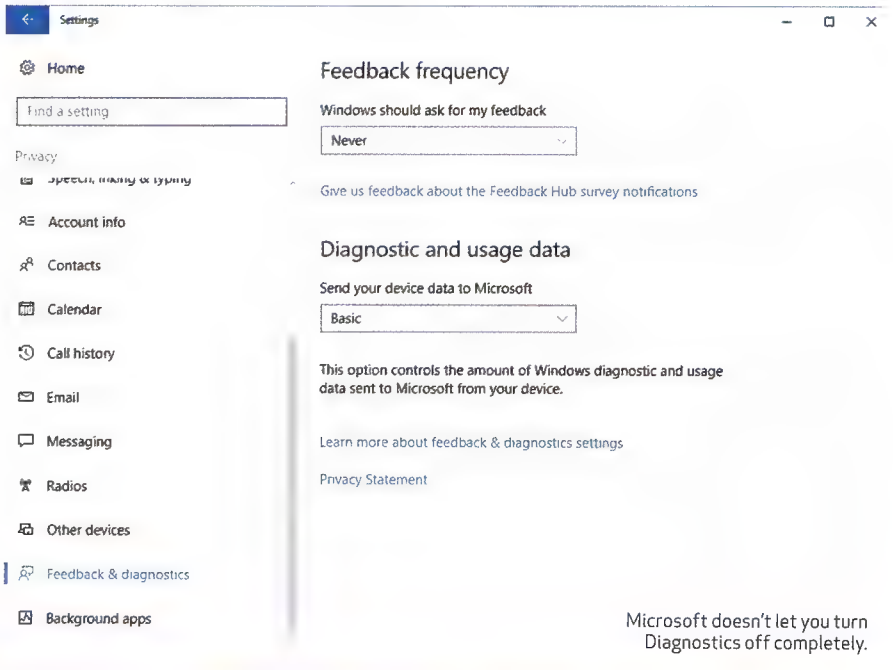
HKEY_LOCAL_MACHINE\SOFTWARE\Policies\Microsoft\Windows\DataCollection

Then you create a new DWORD (32-bit) Value in that key named AllowTelemetry, with a value of 0.

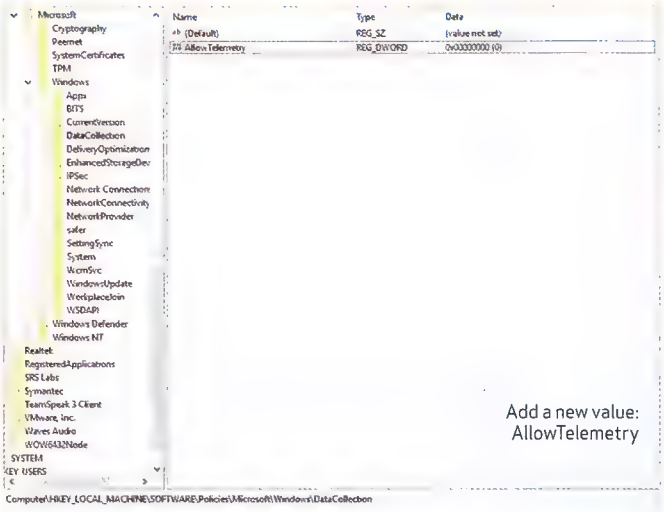
The thing is, this won't work for Windows 10 Home and Pro users, in spite of the common belief that it will. Microsoft has said that, on those platforms, a value of 0 is the same as 1 (Basic).



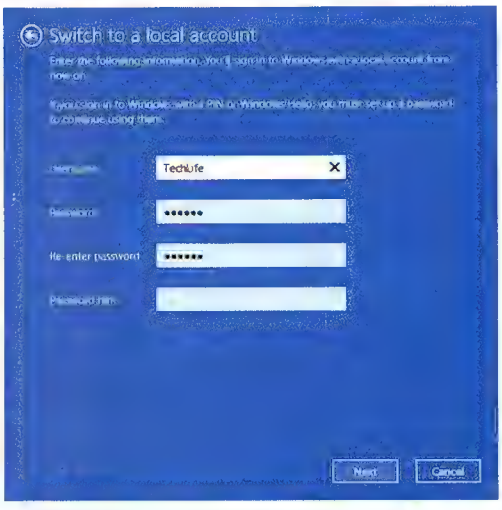
To turn off Cortana, you now need to hack the Windows Registry.



Microsoft doesn't let you turn Diagnostics off completely.



Add a new value: AllowTelemetry



You just need to enter a username and password (it doesn't need to be the same as your Microsoft password).

and Telemetry' in the list of services. Double-click on it to bring up the settings window.

First, click on the stop button to stop the service right now. Then, under Startup type, change the option to 'Disabled', so it won't start when Windows does.

You should repeat this process for the 'dmwappushservice' service.

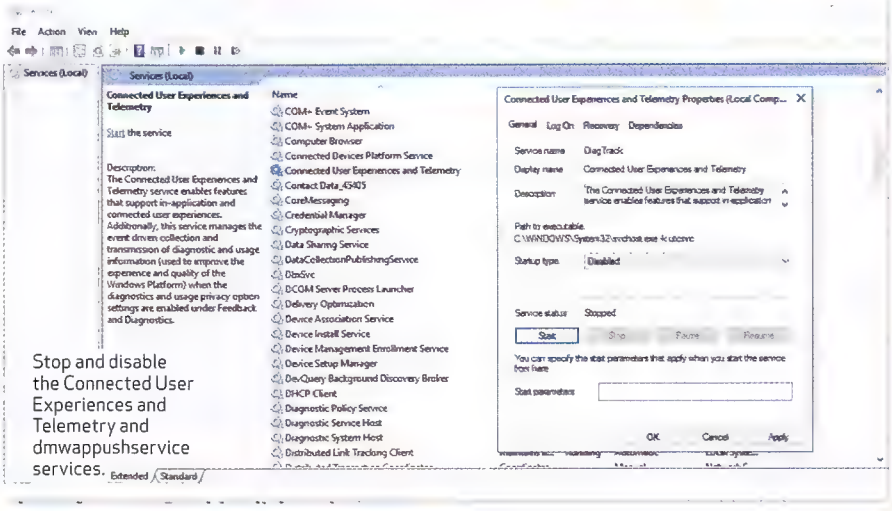
USING A LOCAL LOGIN

Windows 8 introduced the ability to log in to your system with a Microsoft account, much the same way that Google does on mobiles. This has its conveniences – it automatically logs you into a bunch of Microsoft services like OneDrive, Skype and Outlook Mail. But it also allows Microsoft to monitor your activity and link it to a specific account in ways that an old-style local login does not. That includes keeping a log of system searches and login locations. You can, however, switch back to a local login and still use a Microsoft account for specific services. Go to 'Settings > Accounts' and click on the 'Sign in with a local account instead'. You'll be asked to enter your Microsoft password, and then create a new username and password. After that, you'll log in to Windows with this new password.

KILLING CORTANA

By default, whenever you use the search bar in Windows 10, you're also using Bing/Cortana, since that's where it draws it web search results from. That means anything you search for in that bar also sends a request to Microsoft – which can then be logged and that info attached to your account if you're logged in. If you primarily just use the search bar for local searches (like finding documents on your system), you can turn this .

Unfortunately, the Anniversary Update of Win 10 late 2016 actually made it quite hard to do this.



Stop and disable the Connected User Experiences and Telemetry and dmwappushservice services.

O&O ShutUp10

If you don't want to make changes manually, there's a handy app called O&O ShutUp10, available at www.oo-software.com/en/shutup10. It goes through and makes many of these changes for you – as well as a few others besides. It's the quick way to instantly harden Windows against Microsoft's spying.

Fire up regedit and go to: **HKEY_LOCAL_MACHINE\SOFTWARE\Policies\Microsoft\Windows\Windows Search**

If you don't have a Windows Search key, you'll have to create one by right clicking on Windows and selecting 'New > Key', just as if you were creating a new directory.

Then you have to create a new DWORD (32-bit) Value called 'AllowCortana'. Right click on the Windows Search key you just created and select 'New > DWORD (32-bit) Value' and name it AllowCortana. Its value should be 0 (the default). Once you reboot, Cortana should be off. You can turn it back on again by changing the value to 1. Once you've done that, you'll notice the search bar text will change from 'Ask me anything' to just 'Search Windows.' You'll only get local results from a search.

If hacking the registry is too much, then you can at least limit what Cortana can access. In the search bar, type "cortana". One of the links should be 'Cortana & Search Settings', so click on that. You can switch all the main settings to 'off'. Then click on the Notepad on the left, go to 'Permissions' and turn those off too.

WINDOWS DEFENDER

Windows Defender will by default send samples and information back to Microsoft for 'analysis'. You can turn this off as well. Head to 'Settings > Update & Security'. Click on Windows Defender and uncheck the boxes for Cloud-based Protection and Automatic sample submission.

And that should be about it. With all of the above, your computer should be talking to Microsoft as little as possible. Which is just the way we want it. ■

Prevent Windows Update reboots

Microsoft doesn't make it easy, so Nathan Taylor is here to guide you through the various methods to stop your PC from rebooting itself.

It is, for a great many people, Windows' biggest annoyance of all: the update reboot. You wake up in the morning to find that your computer has mysteriously rebooted itself, a realisation that is frequently followed by panic. "Did I save that document I was working on? Can I get my browser tabs back? How will I get my work done when that process job I left running overnight was interrupted?"

Amazingly, there's no simple way in the regular settings of Windows 10 to turn such reboots off. You can choose to turn off automatic Windows Updates, but that's very bad security policy. Better to try one of the methods below.

THE REGISTRY FIX

By adding a single line to the Windows Registry, you can disable automatic reboots. Just follow these steps:

1 Press 'Win-R' and enter `regedit` into the RUN field.

2 In the registry structure, navigate to: **HKEY_LOCAL_MACHINE\SOFTWARE\Policies\Microsoft\Windows\WindowsUpdate\AU**

3 You may find that you do not have a WindowsUpdate and/or AU key. Don't worry: you can create them. Right click on the Windows key and select 'New > Key' and type in `WindowsUpdate`, just as if you were making a new directory in File Explorer. Do the same again in WindowsUpdate to create an AU directory.

4 Right click on the AU key and select 'New > DWORD (32-bit) Value'. Name it 'NoAutoReboot WithLoggedOnUsers'.

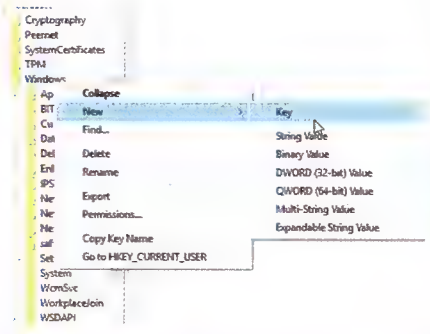
5 Double click on this new value and change the Value data to 1 and click OK.

6 The changes won't take effect until the next reboot. After that, when updates are pending, you'll see in the reboot menu 'Update and shut down' and 'Update and reboot' as options instead of the regular shutdown and restart.

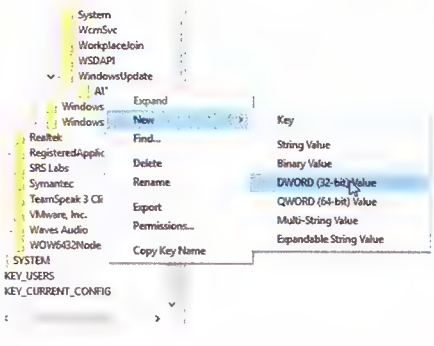
Making the reboot pending dialogue box go away.

You know that dialogue box that keeps popping up after a Windows Update telling you it need to restart in order to finish?

Normally, you can't make that go away permanently, you can only postpone it for up to four hours. To abort the scheduled reboot completely, you need to right click on the Start button and select Command Prompt (Admin). Then, in the command prompt type `shutdown /a`. This will abort the pending restart.



You may have to create some new keys.



Create a new value, NoAutoRebootWithLoggedOnUsers.

OTHER WAYS THAT WORK

If you don't like editing the registry by hand (and we understand that the prospect can be quite daunting for first-timers), there are some other options to try.

- Head to **tinyurl.com/apc437-symantec**. Symantec has created the key for you. Download and unzip, then right click on 'Enable file in File Explorer' and select 'Merge'. This will accomplish the same thing as the guide earlier.
- Download a shutdown blocker like ShutdownGuard (**github.com/stefansundin/shutdownguard**).
- Use the task scheduler. Right click on the Start button and select computer management. Go to 'System Tools > Task Scheduler > Task Scheduler Library > Microsoft > Windows > UpdateOrchestrator'. Right click on Reboot and change it to 'Disabled'.

  But we're not quite done here yet. You then have to go to the folder 'Windows > System32 > Tasks > Microsoft > Windows > Update Orchestrator' in File Explorer. Right click on the Reboot file and select 'Properties'. Then go to the Security tab and click on 'Advanced' and change the ownership of that file to your user account.

  Then, one by one, disable write access to that file from all other accounts. (This is done to prevent Windows from overwriting your changes. You can now see why the registry editor version is quicker and easier!)

Windows 10 Pro and Enterprise users have a different option – the Group Policy Editor.

In the RUN or search bar, type `gpedit.msc`. Go to 'Computer Configuration > Administrative Templates > Windows Components > Windows Update' and you'll see a setting for 'No auto-restart with logged on users'. Double click on it to enable it. ■

Build the ultimate Windows repair disc

Turn panic into minor irritation by crafting your own customised recovery disc or USB drive with Nick Peers.

One of the most stomach-churning moments in any PC user's life is when you switch on your computer to do some work or let off some steam, only to find Windows won't boot. You may get lucky – Windows 10 is smarter than previous versions, and can resolve certain issues on its own, but in many cases, you're left in an endless reboot loop. Assuming Windows even gets that far...

But if Windows can't fix itself, what next? Do you have a recent backup of your data? What about Windows itself? Of course, it's perfectly possible to reinstall Windows from scratch, but that's the best part of a day lost to restoring your PC.

The solution lies in creating a bootable recovery disc – one that gives you the tools to repair most Windows woes, remove malware and lets you pull data off the drive in case you're forced to bite the bullet and reinstall. In an ideal world, you'd be able to build a single rescue disc to cover all your needs. Linux users can smirk at this point, and bring out their Live CDs, giving them full-blown access to the OS they know and love. Wouldn't it be great if you could do the same in Windows?

The answer is: you can. In this feature, we'll show you how to create all the recovery media you'll ever need. The first disc will give you access to basic Windows recovery options, plus allow you to reinstall Windows if all else fails. The second offers more quick fixes to resolve common boot and loading problems, plus provides opportunities to recover files and back up or restore disk images. The final disc gives you the closest thing to a Linux Live CD: a fully functioning Windows-like environment to work in, with tools to help you troubleshoot problems, get online and even add your own custom apps to beat malware and perform other tasks.

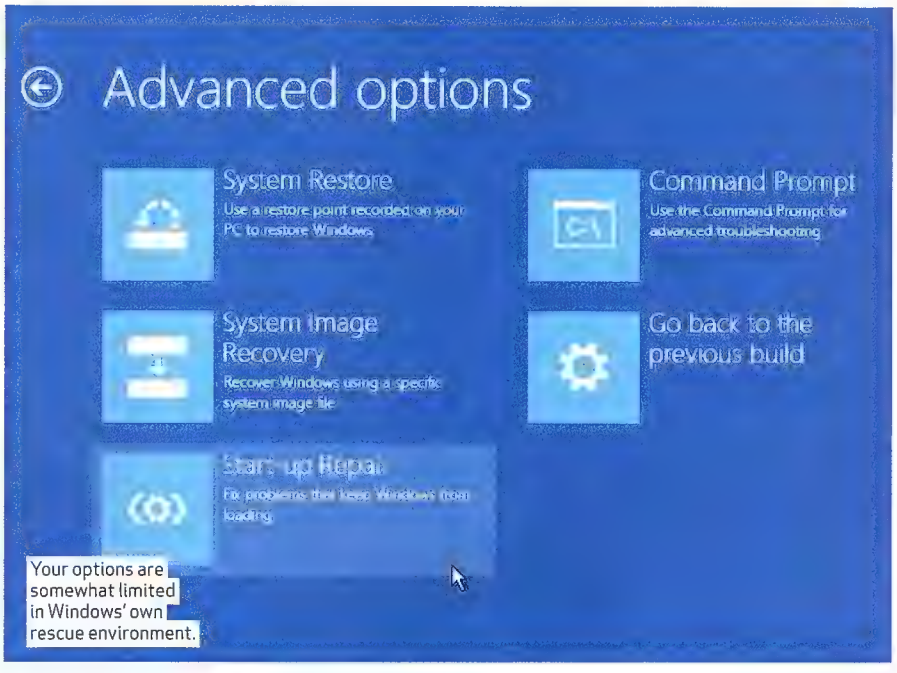
The time to create this media is right now, while your PC is still working, so turn the page and protect yourself against disaster.

Our first recovery disc is – as it's always been – the humble Windows installation disc. Can't boot into Windows? Boot from this instead, choosing the 'Repair your computer' option when prompted. From here, you can attempt to fix startup problems automatically, launch System Restore to try rolling back to a previously working installation, or even restore Windows from a disk image. Advanced users can dig deeper, with access to the command prompt, too.

These days, most of us don't bother with DVDs, so it's unlikely that you've got any installation media to hand. Let's begin, then, by rectifying that situation. Start by typing "recovery" into the Cortana search box, then choose 'Create a recovery drive'. You're prompted to back up system files to it, which effectively creates a full-blown reinstall disc – you need an 8GB flash drive if you go down this route. Alternatively, uncheck the 'Back up system files to the recovery drive' box, and make do with the basic repair options – in which case, all you need is a 512MB USB flash drive, although you won't be able to reinstall Windows if you go down this route.

(Note: If you want to create a bootable DVD, you need the Media Creation Tool – download the latest version from **www.microsoft.com/software-download/windows10**, and choose the ISO option when creating media for another PC, then right-click this file, and choose 'Burn disc image' to burn your disc.)

From here, if Windows fails to boot, pop in your installation disc or drive, and either make it your first bootable device in the BIOS, or look for an option to choose the boot device at startup, choosing the rescue media when prompted – note, if you're shown two options (typically UEFI and USB), choose UEFI. From here, you can follow the prompts to hopefully bring your PC back to life, or – if all other avenues fail – reinstall Windows from scratch.


Advanced options
System Restore
Use a restore point recorded on your PC to restore Windows
Command Prompt
Use the Command Prompt for advanced troubleshooting
System Image Recovery
Recover Windows using a specific system image file
Go back to the previous build
Start up Repair
Fix problems that keep Windows from loading
Your options are somewhat limited in Windows' own rescue environment.

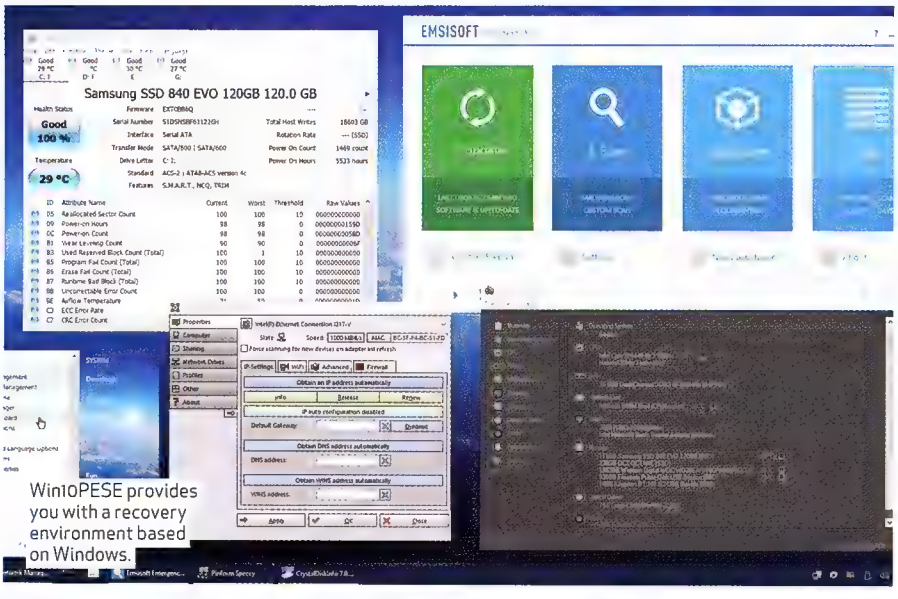
BEYOND THE BASICS

The Windows repair tool is all well and good, but there are times when it can't help. It can't disinfect your malware-infested drive, for example, and neither can you easily copy files from a badly mangled Windows installation, before formatting the drive, and starting again.

If you want to protect yourself (and your PC) against either of these two possibilities, you need to augment it with something else.

Most anti-malware vendors offer a recovery disc solution that specialises in rooting out malware – see the box opposite for details about creating a fourth recovery disc if you decide against the full-blown Live CD option later on in this feature. In the meantime, our second recovery disc takes things one step further than the Windows install disc. Lazesoft Recovery Suite Home Edition is free (for non-commercial use), so start by downloading and installing it from **www.lazesoft.com/lazesoft-recovery-suite-free.html**.

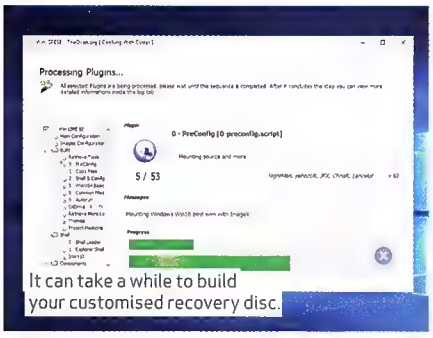
Lazesoft Recovery Suite contains four key components, all of which can be run directly from Windows (even in Safe mode). Of course, we're interested in building recovery boot media, so after launch, click the 'Burn CD/USB Disk' link. You're asked to specify the target version of Windows – leave the default 'DO NOT specify' setting applied for Windows 10 support, then click 'Next'. Choose your target media: CD/DVD, USB or ISO file, then click 'Start'. Once created, check out the box over the page to find out what sort of problems Lazesoft can attempt to fix.



WinToPESE provides you with a recovery environment based on Windows.

ONWARD AND UPWARD

Lazesoft Recovery Suite is well worth using in case it can fix your problem with just a few clicks, but what if it can't? In an ideal world, you'd be able to boot into a more complete Windows-like environment – one that employs the familiar point-and-click interface, while giving you access to a wider range of tools, full internet access



It can take a while to build your customised recovery disc.

(being able to research error messages online could be a crucial step toward solving your problem) and even more besides.

The good news is that all of this is possible – Microsoft produces a specialised version of Windows called Windows PE, with 'PE' standing for 'Pre-installation Environment'. It's designed to be run directly from removable media and has been adapted over the years by various individuals to provide recovery discs that can give you the best of all worlds – think Bart PE (based on Windows XP) and AOMEI PE Builder (Windows 7 or 8, but not 8.1 or 10).

One of the most successful PE-building tools is WinBuilder, and one user-friendly variant for Windows 10 comes in the form of Win10PESE. It's a flexible custom recovery tool builder that enables you to incorporate additional apps and tools if you need them, and can be burned to DVD or USB flash drive (1GB or larger).

BUILD YOUR OWN CUSTOM RECOVERY DISC

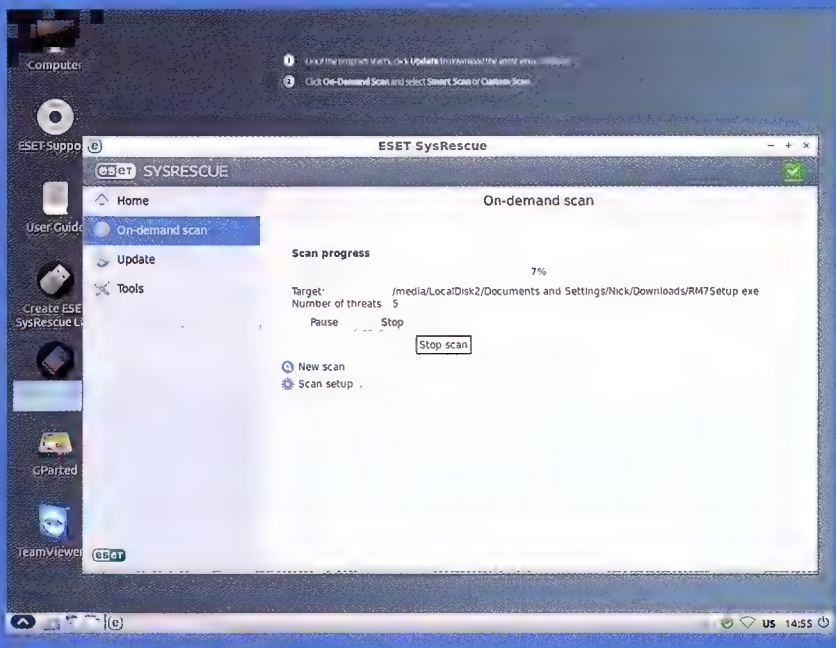
Start by visiting **win10se.cwcodes.net/Compressed** and clicking the link under the 'Package' column to save the recovery builder tool in ZIP format to your hard drive. Once done, right-click the ZIP file, and choose 'Extract All', then open the 'Win10PE_SE_<date>' folder (the <date> corresponds to the latest build number) and double-click 'BuilderSE.exe' to get started. The WinBuilder main screen reveals all the basic steps that you need to follow.

One of those steps involves giving the builder access to Windows 10 installation media – sadly, your recovery drive (or a disc created using the Media Creation Tool) doesn't count. Instead, click the 'Microsoft Windows and Office ISO Download Tool' link in WinBuilder to access a tool that downloads the Windows 10 ISO. Once downloaded, launch the app, select 'Windows 10', then choose the 'Windows 10 Home/Pro' link from the drop-down menu, before clicking 'Confirm'. Choose your language, click 'Confirm' again, then pick the 64-bit or 32-bit download, based on which version you currently have (press Windows-Pause/Break to find out if you're not sure), to download the ISO file.

Next, double-click the ISO file to allow Windows to mount it as a virtual CD/DVD drive (it'll be visible in File Explorer). Now return to Win10PESE, and click the 'Source' button. Click the folder button under 'Source Directory' to select the virtual disc drive.

In the program's left-hand pane, you'll see a number of collapsible folders that, when opened, reveal additional settings. If you're in a hurry, you can skip all of these to generate a basic, but usable, ISO file – just click the play button, sit back and wait for the disc to be created.

Once complete, look inside the 'Win10PE_SE_<date>\ISO' folder for the ISO file you can subsequently burn to disc, by right-clicking the file and choosing 'Burn disc image'.



Malware recovery tools

One of malware's nastiest tricks is to cripple your PC so it's virtually impossible to clean. The malware typically suppresses known security tools from running, plus locks down your system in various ways, such as restricting which websites you can visit, barring access to Registry Editor, and even crippling Safe mode, inside which most anti-malware tools can at least attempt to clean up the mess. To be fair, Windows 10 makes it hard enough to access Safe Mode these days, so we're not sure why malware bothers, but we digress.

The solution here lies in visiting your security vendor's site to locate recovery media that includes a special version of your anti-malware product that has network access to update itself, then focuses on detecting and cleaning malware. Depending on the tool and the infection, you should find any collateral damage has also been repaired, although tools such as Windows Repair (**www.tweaking.com**) and Complete Internet Repair (**www.rizonesoft.com**) can be used in Windows proper after the malware has been scrubbed if this doesn't prove to be the case.

These tools are completely free to use, so you don't need to be a paying purchaser of a particular package to use it. Just download the ISO file to the hard drive of a clean, working PC, then right-click it, and choose 'Burn disc image' to burn a DVD from it, or use a tool such as Rufus (**rufus.akeo.ie**) to create a bootable USB flash drive from the ISO's contents, if the vendor in question doesn't provide a live CD/USB creation tool.

Major anti-malware vendors offering bootable recovery discs include Kaspersky (**support.kaspersky.co.uk/4162**), Norton (**security.symantec.com/nbrt/nbrt.aspx**), ESET (**www.eset.com/int/support/sysrescue**) and AVG (**www.avg.com/ww-en/download.prd-arl**). Just Google your anti-malware vendor and the words "recovery disc" or "rescue disc" to see if it's covered.

If you're creating a bootable USB recovery drive, however, you should take the time to expand the 'WriteMedia' section. If your PC has a 64-bit UEFI (check with the manufacturer), select the 'Copy to USB-Device' box; if not, select 'Copy to USB-Device BCD Bootloader' instead, and check 'Add Grub2-EFI (x64 UEFI only)' to ensure it boots. Click the folder button under 'Please select the root directory of your USB-Device', to select the correct drive letter if necessary, then click 'Copy to USB' to build your recovery drive from the ISO you just created.

BEYOND THE BASICS

You can now test the recovery drive by booting from it in the same way you'd boot from the previous two recovery options. A menu appears – select 'Win10PESE' to boot into your recovery environment. When the desktop environment pops up, you're prompted to choose your network connection type, if one is detected – the default DHCP is automatically selected after a five-second pause.

You then find yourself at a close approximation of the Windows 10 desktop, albeit one employing a more 'classic' Windows look and feel. You'll see convenient shortcuts to File Explorer, the Command Prompt and PENetwork on both the Taskbar and desktop – there's also a shortcut to Firefox, giving you access to the web. PENetwork merely launches the network manager, which should already be running and accessible from the Taskbar Notification area, alongside other controls, including one that enables you to set a different desktop resolution if you wish (note this feature doesn't work very well on UEFI systems – you're likely to find only the 1,920 x 1,080 and 1,024 x 768 options work).

Click the Start button, and select 'All Programs' to see what tools and utilities are included with the vanilla Win10PESE disc – shortcuts to critical Control Panel and system management applets are included, as are a handful of file-related tools (including 7-Zip), BootICE (for managing the boot manager), a PDF viewer and some handy system tools, including Remote Regedit (for manipulating your Registry in case your boot problems stem from there), as well as access to the System Recovery options found in Windows itself.

These tools are all welcome and helpful, but you may be hankering after different tools and utilities – you may even simply want to be able to run a particular app, such as a word processor, while you try to fix your boot problem. The good news is that your Win10PESE environment can support third-party applications and programs, too.

We say 'some' because, while certain program installers work, on the whole, you're limited to portable apps, namely those that run directly from a folder. You can download these from the internet (look under X:\Users\Default

Lazesoft Recovery Suite Home
Lazesoft
Windows Recovery
Welcome
One Click Fix
BootCrash
LoadingCrash
RandomCrash
RestoreDisk
FinalSolution
RepairTools
Overview
One Click Fix Crash Solution
A fast and easy way to fix the crash problem. We recommend the feature for novice users.
This feature is also undoable. If you are not satisfied with the repair results, you can
click <Undo> to cancel all the modification with this option.
Boot Crash Solution
When you start the computer, it ALWAYS crashes with a black screen, You are NEVER able to
get to the Windows loading bar. You might observe an error message such as: "Ntldr is missing"
or "error loading operating system", etc on the black screen.
Loading Crash Solution
When you start the computer, it ALWAYS crashes at the Windows loading bar on the welcome screen.
You might observe freezing, rebooting repeatedly, a blue screen, etc.
Random Crash Solution
When you start the computer, it ALWAYS crashes at the Windows loading bar on the welcome screen.
You might observe freezing, rebooting repeatedly, a blue screen, etc.

Fix Windows boot problems

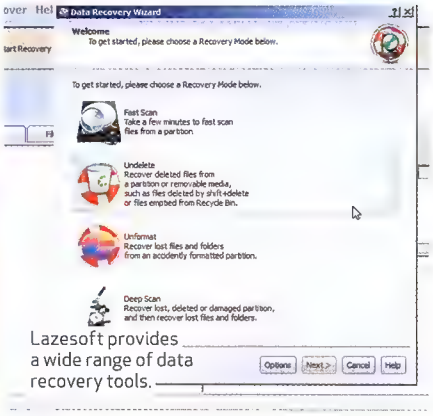
Lazesoft Recovery Suite offers a number of handy tools for fixing problems with Windows, plus it can help you recover data, too. Once created, reboot your PC from the Lazesoft rescue media. You'll eventually find yourself at the main Lazesoft Recovery Suite, with four recovery-based options: Windows Recovery, Data Recovery, Disk Image & Clone and Password Recovery.

All four options are largely self-explanatory. Before running any recovery tools, we recommend taking a drive image of your current setup, which ensures you can always roll things back should the cure prove worse than the malady. Select 'Disk Image & Clone' and choose 'Drive to Image' to back up to a suitable external drive. Second, 'Data Recovery' contains the full range of data recovery options, including simply pulling off regular files, as well as searching for lost and deleted files and partitions.

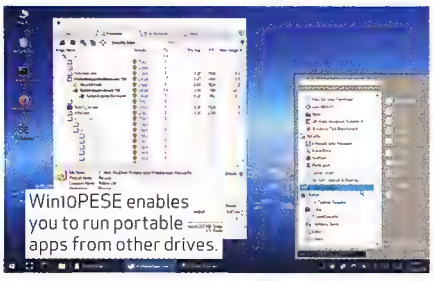
'Windows Recovery' attempts to fix your boot problems, offering a wide range of options across a series of tabs. There's also a one-click solution if you'd prefer the software to try to diagnose and repair on its own, with an 'Undo' button that promises to reverse any changes made if the problem isn't fixed or gets worse.

If this fails, try the other options: 'BootCrash', 'LoadingCrash' and 'RandomCrash'. Each one steps you through a series of potential fixes to try, from repairing the MBR and restoring missing or corrupted files, such as Ntoskrnl.exe (BootCrash), to running memory diagnostics and recovering the Registry (RandomCrash).

The final tool – 'Password Recovery' – promises to reset your Windows password if you've forgotten it, plus can reveal your Windows and Office product keys, should you need them. The former option only works with local passwords – in other words, if you sign in to Windows using your Microsoft Account, you need to visit **account.live.com/password/reset** to try to fix the problem.



Lazesoft provides a wide range of data recovery tools.



Win10PESE enables you to run portable apps from other drives.

for the Downloads folder), but be sure to copy portable apps and key files to another drive if you want to keep them for another session – the 'X' drive resides only in memory, which means it's wiped the moment you reboot.

BRING YOUR OWN

Luckily, you have a number of options should you wish to build up a more permanent collection of tools and utilities. Portable apps can be stored on another drive – a USB flash drive, say, or shared network folder. Access them via the Windows PE environment when needed.

A more elegant solution, and one that incorporates your applications directly into your recovery drive (with shortcuts through the Start menu), is to follow the 'Add apps to your drive' box on the right. Also take the time to explore some of the other options that Win10PESE provides. Explore the various sections of the disk-creation tool; expand 'Shell', for example, and you can change the packaged Start menu, plus configure its appearance. Expand 'Components', and you can choose which Windows tools and accessories to include – add the .NET Framework to support a wider range of applications, for example.

If you have a virtual Windows machine to hand using a tool such as VirtualBox (**www.virtualbox.org**), use it to test your recovery disc – open 'VirtualTest' and select 'VirtualBox Emulation' to set up a dedicated virtual machine to test the ISO file with. It's a great way to check to see what effect your tweaks have, without having to recreate a USB flash drive or boot from your PC each time. But do remember to test the final disc or drive on your actual PC when you've got it working to your satisfaction, to make sure.

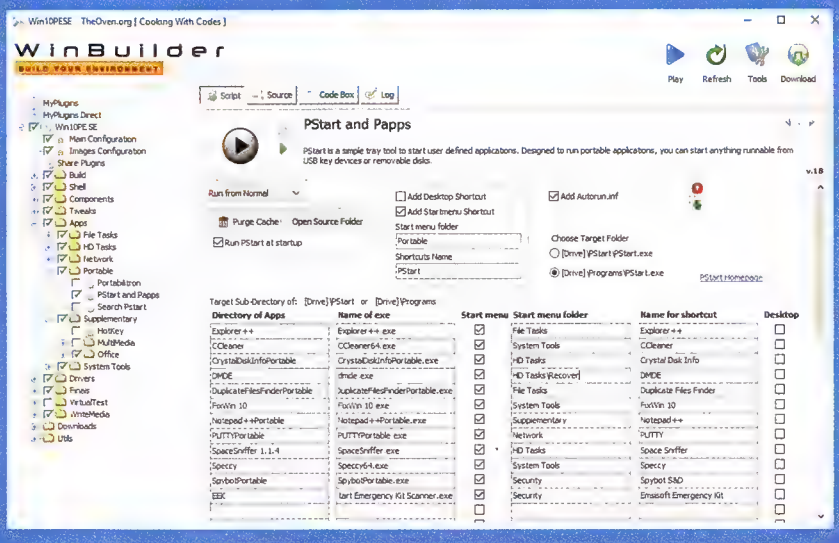
TROUBLESHOOT YOUR PC

Your recovery discs have been created, waiting for the time they'll be needed. Now your PC is refusing to boot and you've whisked out your recovery discs. What to do?

First, we recommend taking a drive image of the system partitions before you start attempting to fix things. Use Lazesoft for this task, unless you have an emergency boot disc coupled to your existing system imaging tool (such as Macrium Reflect Free) – in which case use that.

With the drive image in place, you can start to attempt a fix for your problem. Begin with your Windows installation disc, to see if its Automatic Repair tool can get Windows up and running again. Make a careful note of any error messages if the problem persists, then move on to Lazesoft's Windows Recovery component (see the box on the previous page). If Lazesoft's fix-it tools fail to fix your loading problems, bring out the Win10PESE disc. Boot from this, then use the tools onboard – such as Remote Regedit – to try to fix known problems.

Don't forget your internet connection – use Firefox to browse for possible solutions to error messages, plus download additional software you might need, but that you didn't include on the disc. This is particularly handy if you're battling malware infections – you can track down specific removal tools or locate your vendor's portable scanning toolkit, should our other suggestions fail to yield results. ■



Add apps to your drive

Why plug in another USB drive, or download tools from the net, when you can embed any portable tool directly into your recovery drive? Once embedded, the tools can be directly accessed through Win10PESE's Start menu, or via an icon in the Taskbar Notification area.

To add apps to your drive, first expand the 'Apps > Portable' section in Win10PESE's left hand pane, then check 'PStart and Papps'. Next, click the 'Open Source Folder' button to open the folder where your portable apps need to be collected, each one inside its own folder. Once you've copied them into here, return to Win10PESE, and carefully enter the folder name of each app under 'Directory of Apps', plus the name of the program's executable file under 'Name of exe'.

To add a shortcut to the Start menu, check 'Start menu' and then specify the folder (get this from Projects\Win10PESE\Apps), and shortcut name; you can add a desktop shortcut, too, by checking the appropriate box. Finally, if you're burning a DVD, rather than creating a USB recovery drive, be sure to select 'Run from RAM' to allow any anti-malware tools to download and process updates. Then create the disc in the usual way.

What sort of portable apps should you be looking to add to your toolkit? Two recommended anti-malware tools are Emsisoft Emergency Kit (**www.emsisoft.com/en/software/eek**), which utilises two anti-malware engines, and Malwarebytes Junkware Removal Tool (**www.malwarebytes.com/junkwareremovaltool**) for PUPs.

Piriform (**www.piriform.com**) provides portable versions of CCleaner (cleanup tool), Recuva (data recovery) and Speccy (system information). Another data recovery tool worth adding is DMDE Free (**dmde.com**), while a wide array of tools from alternative browsers, to disk encryption, to drive health monitoring utilities can be found at **www.portableapps.com**.

Finally, if there's a specific utility you want, check with the vendor's website – often, you can find portable builds buried away in the downloads section.

Intel's 7th-gen finally arrives on desktop

The wait for Kaby Lake on desktop may be over, but was it worth it? Josh Collins tests the chip giant's new desktop Core i3, i5 and i7 CPUs alongside seven Z270 motherboards from the top vendors.

Intel's latest processor and platform controller hub (PCH) is one we're already fairly familiar with from its mobile variant, which landed about six months ago. Codenamed Kaby Lake, this successor to Skylake supersedes the Z170 platform and 6th-generation Core i processors, replacing them with a new Z270 motherboard platform and and 7th-gen processors. However, as with the last couple of Intel platform updates, these new parts demonstrate an evolution rather than revolution – namely further iteration of the 14nm manufacturing process and refinement of a microarchitecture that we've, frankly, got to know pretty well by now.

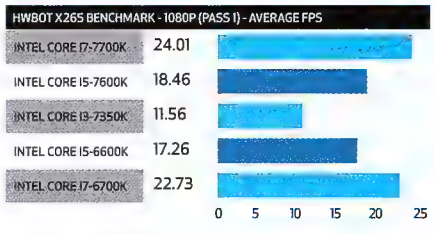
This new chipset feels akin to the move from Z87 to Z97 – a 'jump' which caused many PC enthusiasts to scratch their heads and wonder, "What's new?" Frustratingly, we're once again confronted by this kind of scenario where the updates are, at this point, minimal.

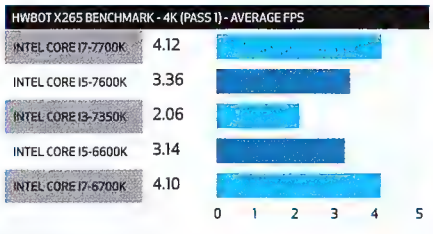
We say "at this point" because the core feature driving interest in the new Z270 platform, which is Intel's much hyped Optane memory technology, isn't actually launching with the Z270 platform. It will come later, though exact details are yet unknown. At the time of going to print, we have been advised of an upcoming Intel briefing; however, to bring this feature article and review roundup to you to meet the launch schedule, we've reached out to the motherboard vendors to help source the required CPUs for testing. Intel has been quiet, to say the least.

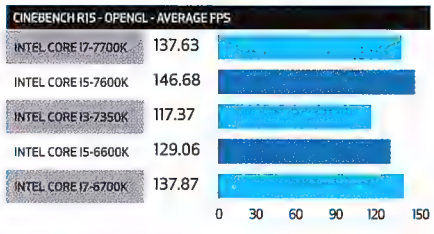
Regardless of the circumstances, what we've found through rigorous testing is a platform that simply feels like much the same, just slightly tweaked and bumped. The Core i7 and Core i5 K SKU CPUs carry a 300MHz clock speed increase, though this becomes somewhat redundant given the target, overclocking savvy market segment. But we do have a new Core i3 K SKU to explore, so read on to find out what's hot and what's not – literally, even.

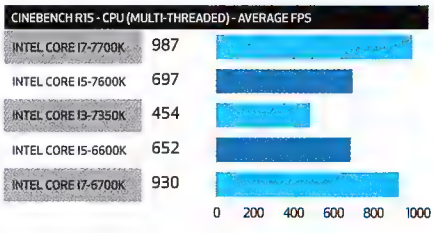
LABS BENCHMARK RESULTS

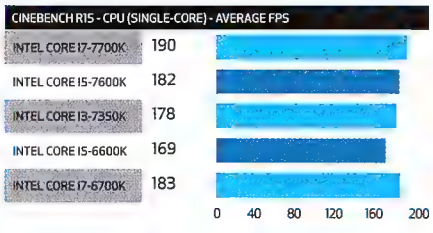
GENERAL & ENCODING PERFORMANCE


HWBOT X265 BENCHMARK - 1080P (PASS 1) - AVERAGE FPS
INTEL CORE I7-7700K 24.01
INTEL CORE I5-7600K 18.46
INTEL CORE I3-7350K 11.56
INTEL CORE I5-6600K 17.26
INTEL CORE I7-6700K 22.73
0 5 10 15 20 25

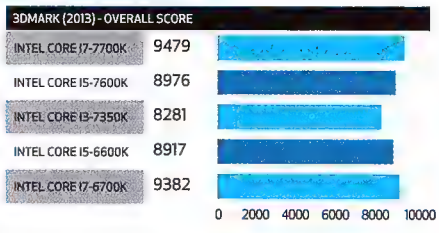

HWBOT X265 BENCHMARK - 4K (PASS 1) - AVERAGE FPS
INTEL CORE I7-7700K 4.12
INTEL CORE I5-7600K 3.36
INTEL CORE I3-7350K 2.06
INTEL CORE I5-6600K 3.14
INTEL CORE I7-6700K 4.10
0 1 2 3 4 5


CINEBENCH R15 - OPENGL - AVERAGE FPS
INTEL CORE I7-7700K 137.63
INTEL CORE I5-7600K 146.68
INTEL CORE I3-7350K 117.37
INTEL CORE I5-6600K 129.06
INTEL CORE I7-6700K 137.87
0 30 60 90 120 150

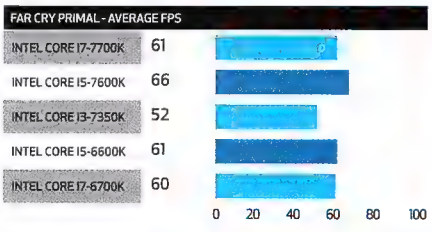

CINEBENCH R15 - CPU (MULTI-THREADED) - AVERAGE FPS
INTEL CORE I7-7700K 987
INTEL CORE I5-7600K 697
INTEL CORE I3-7350K 454
INTEL CORE I5-6600K 652
INTEL CORE I7-6700K 930
0 200 400 600 800 1000

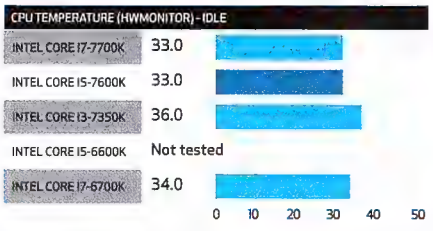

CINEBENCH R15 - CPU (SINGLE-CORE) - AVERAGE FPS
INTEL CORE I7-7700K 190
INTEL CORE I5-7600K 182
INTEL CORE I3-7350K 178
INTEL CORE I5-6600K 169
INTEL CORE I7-6700K 183
0 40 80 120 160 200

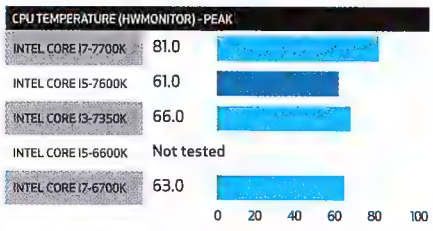
GAMING PERFORMANCE



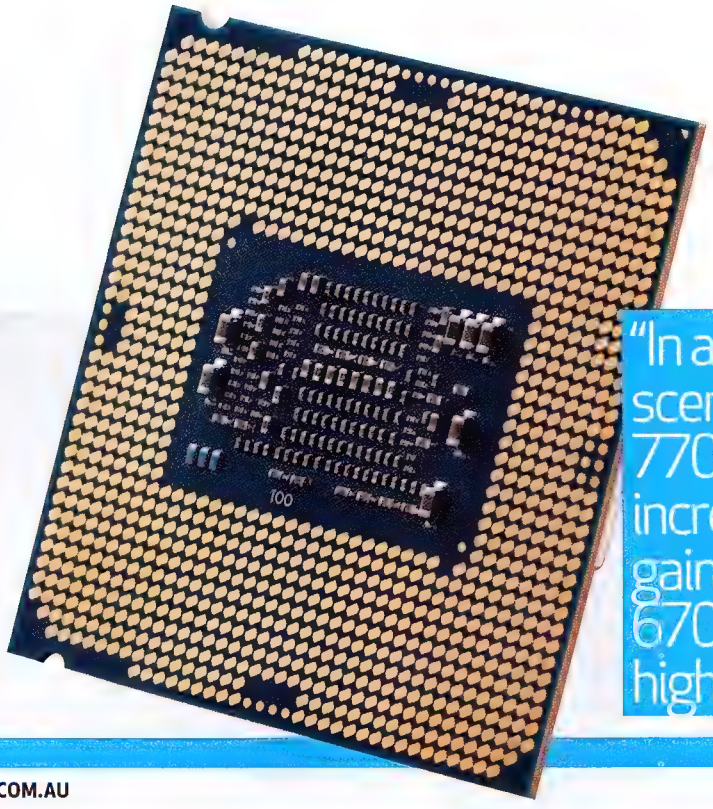
THERMAL PERFORMANCE


FAR CRY PRIMAL - AVERAGE FPS
INTEL CORE I7-7700K 61
INTEL CORE I5-7600K 66
INTEL CORE I3-7350K 52
INTEL CORE I5-6600K 61
INTEL CORE I7-6700K 60
0 20 40 60 80 100


CPU TEMPERATURE (HWMONITOR) - IDLE
INTEL CORE I7-7700K 33.0
INTEL CORE I5-7600K 33.0
INTEL CORE I3-7350K 36.0
INTEL CORE I5-6600K Not tested
INTEL CORE I7-6700K 34.0
0 10 20 30 40 50


CPU TEMPERATURE (HWMONITOR) - PEAK
INTEL CORE I7-7700K 81.0
INTEL CORE I5-7600K 61.0
INTEL CORE I3-7350K 66.0
INTEL CORE I5-6600K Not tested
INTEL CORE I7-6700K 63.0
0 20 40 60 80 100

NOTE: ALL CPUS AND MOTHERBOARDS THIS MONTH WERE TESTED WITH THE NOCTUA NH-U12S COOLER, NVIDIA FOUNDERS EDITION GEFORCE GTX 1080, SAMSUNG 950 PRO NVME SSD, 2 X 4GB CORSAIR DOMINATOR PLATINUM DDR4-3000 (15-17-17-35-2T) AND CORSAIR AX1200I PSU USING WINDOWS 10 (64-BIT) AND GEFORCE 376.09 DRIVERS.



"In a stock versus stock scenario, the Core i7-7700K does deliver an incremental performance gain over the Core i7-6700K due to a 300MHz higher boost clock."

PROCESSOR

$549 | WWW.INTEL.COM.AU

Intel Core i7-7700K

Iteration: the current Intel game.

The new Intel Core 7th-gen processor, codenamed Kaby Lake, is a frustrating release for consumer desktop PC enthusiasts. With Intel moving away from its Tick-Tock release sequence and switching to Process, Architecture, Optimization (PAO), the barrage of shrinking manufacturing processes that the market had become accustomed to has slowed. With the chip-making giant switching to PAO, this slowdown is now acknowledged.

Bucking the trend set by Moore's Law of doubling transistor count, as shrinking manufacturing processes become ever harder to facilitate, the Kaby Lake release for some will be met by a slight raise of the eyebrow and a soft sigh. For others, it will be intriguing.

The Intel Core 7th-gen processors have been around for a while (at least in the eyes of the tech world) for those watching the mobile CPU space. However, it has taken numerous months for the desktop variant, Kaby Lake-S, to reach the consumer market. It will be longer still for the high-end desktop (HEDT) market, still rocking away with Haswell-E and Broadwell-E on the X99 LGA2011-v3 platform, now a generation behind the consumer -S desktop variant microarchitecture.

For those that are intrigued by the crossover of mobile technologies to the desktop space, the updated handling of 4K HVEC encoding and decoding via a hardware-based implementation in Kaby Lake versus the hybrid solution found in Skylake will make some smile. This potentially opens the door for 4K Netflix on desktops and other high-res, high-bitrate audio-visual services such as Sony's Ultra, currently only available on Sony's smart TV range, due to hardware- based DRM solutions. There are also additional VP9 encode and decode hardware optimisations to deliver improved performance for YouTube high-res, high-bitrate video consumption. This hardware-based optimisation leads to lower power draw and improved power consumption figures during these activities.

Delivering yet again a four-core, eight-thread solution, there is little news on the multi-threading front for this release, leaving consumer desktop users with a single choice of stepping up to the more expensive, thinly veiled server and workstation technology of the X-series platform, currently Intel's X99. While the X-series platform has seen progression from six to eight and now ten core options with twice as many threads, it can't help but to feel like the Z platform is lagging in its core count progression.

In a stock versus stock scenario, the Core i7-7700K does deliver an incremental performance gain over the Core i7-6700K due to a 300MHz higher boost clock. However, as an enthusiast part, specifically a K SKU, the stock frequencies are rarely maintained by the type of user this processor is aimed at, this therefore makes performance-per-clock an important metric.

The results obtained in the lab lead us to feel let down by the minor step in this generation. While CPU frequency scaling is easier compared to the previous Skylake-S CPUs, this Kaby Lake-S iteration only delivers the improved overclocking scope if you can keep the beast cool.

Verdict

Features	★★★★
Performance	★★★★
Value	★★★½

Your friend in winter and enemy in summer, this CPU will require water cooling to get the most out of it.

★★★½

apc RECOMMENDS

"Like the Core i7 variant, the Core i5-7600K made its gains over the previous generation Core i5 6600K through a stock frequency boost of 300MHz."

PROCESSOR

$390 | WWW.INTEL.COM.AU

Intel Core i5-7600K

The Core i5 K continues as the strong gaming choice.

Like the Intel Core i7-7700K reviewed on the previous page, the Intel Core i5-7600K is based on the Kaby Lake-S micro-architecture, a tweaked – or optimised in Intel speak – implementation of the Skylake-S core found in the Intel Core 6th-gen processors. Check out the Core i7-7700K review for details on the hardware-based encoding and decoding of high- res, high-bitrate audio-visuals.

Coming to the party with four cores and four threads, like the previous four generations of Core i5 K SKU processors (we'll count Haswell and Devil's Canyon as much the same), the crucial differentiator between the i7 and i5 continues to be the implementation of hyperthreading (HT) in the i7 and reduced CPU cache density for the i5.

For many gamers, the Core i5 K SKU is the go-to CPU. This is due to complications arising in some game titles – both new and old games – from the handling of hyperthreading. In addition, the heat generation typically associated with hyperthreading can also be a concern for gamers that may have a small form factor (SFF) solution for LAN gaming, utilising a Micro-ATX or Mini-ITX motherboard and SFF case with potentially reduced cooling capacity.

As a practical example of the Core i5 K SKU having proven gaming chops, the Core i5-7600K delivers similar if not better gaming performance as the more expensive and hotter running Core i7-7700K. This is shown in the graphics score and combined score sub-tests of 3DMark Fire Strike Extreme throughout the testing at stock, 4.5GHz and 4.7GHz frequencies. However, the Core i5 is then pummelled into submission during CPU-centric tests, such as the physics test, ultimately boosting the final 3DMark score in favour of the Core i7. Based on this synthetic test, if your gaming involves plenty of physics processing and you cannot offload this to a secondary or tertiary GPU for processing, the Core i7 is a relevant and practical option to explore.

However, if you play titles more restricted by instructions per clock (IPC), cranking the Core i5 K SKU frequency up delivers comparable performance to the Core i7 clock for clock. The comparable IPC gaming performance and hyperthreading-related gaming loss was observed in the *Far Cry Primal* benchmark results. Showing that the Core i5-7600K continually delivered a faster gaming platform compared to implementing the Core i7-7700K.

However, if gaming is not your focus and content creation is, specifically utilising multi-thread optimised software, the Core i7 becomes the unit best fit for purpose. Understanding the differences of application is key to getting the most out of the choice between selecting a Core i5-7600K or Core i7-7700K, as both are effectively unbound by a CPU frequency limit, with cooling and the silicon lottery the main restraint.

Like the Core i7 variant, the Core i5-7600K made its gains over the previous generation Core i5 6600K through a stock frequency boost of 300MHz. Once this was removed from the equation and compared clock for clock, the differences were minimal.

Verdict

Features	★★★★
Performance	★★★★
Value	★★★★

The pick of the litter for everyday users with a focus on gaming performance and light content production.

★★★★

"Coming in with two cores and four threads, the Core i3-7350K fills a gap within Intel's offerings to the enthusiast market segment."

PROCESSOR

$TBC (ESTIMATED ~$270) | WWW.INTEL.COM.AU

Intel Core i3-7350K

The new K on the block.

This is the CPU many enthusiasts have been wanting for a few generations now. We were teased with the Pentium Anniversary Edition G3258. It was a playful little piece of processing goodness that was a hoot to overclock and play around with, but useful in any decent computing sense for little more than home theatre PC duties. Finally, we now have a K SKU Core i3 to tinker with and enjoy.

Coming in with two cores and four threads, the Core i3-7350K fills a gap within Intel's offerings to the enthusiast market segment. This is good news for many who have enjoyed overclocking for longer than the K SKUs have existed, still fondly remembering obtaining significant performance increases from CPUs that were otherwise overlooked by the general computing public with preference for the more expensive higher-clocked offerings.

With little in the scope of comparison, we are left to draw on similarities. Starting with the aforementioned Pentium Anniversary Edition G3258 that clocked in at 3.2GHz and featuring 3MB of cache, the 7350K is a beefed up piece rocking an impressive 4.2GHz clock speed and 4MB cache. When comparing with the Core i5-7600K, it's an intriguing evaluation as the 7350K possesses two-thirds the cache memory of its higher spec Core i5 sibling – 4MB vs 6MB. However, sporting the same 4.2GHz frequency under load, the two CPUs align closer than enthusiasts may have expected.

Further looking at spec, it begins to make more sense to perceive this "little K" as half of a 7700K. This perspective comes into view when comparing central features, for example 4MB cache vs 8MB, two cores vs four cores and four threads vs eight threads. Not surprisingly, the Core i3-7350K delivers approximately 50% of the performance offered by the Core i7-7700K. This is particularly noticeable in multi-threaded applications such as processing X265 video instructions.

Performance wise, when compared with the other K variants, the Core i3-7350K provides an interesting purchasing scenario. Since the Core i3-7350K still requires a Z platform motherboard for operation, it requires a budget orientated motherboard to make sense as a price-conscious purchasing scenario. Outside of this, the Core i3-7350K presents itself as a CPU to be bought and played with by enthusiasts that own multiple CPUs for the fun of technology, computing and pushing the limits within the boundaries the enthusiast feels comfortable.

For example, an overclocking enthusiast may operate a previous generation platform as their everyday PC – i.e. utilising Z87/Z97 with a 4th-gen Core K processor or transitioning from a Z170 with a 6th-gen K processor, while using the new Z270 and Core 7th-gen offerings as a tool for exploring and fuelling discussion with other enthusiasts on forums and social media.

Whatever niche the Core i3-7350K carves out for itself, it provides an opportunity for PC enthusiasts – gamers, overclockers and hardware nuts alike – to explore the K SKU's flexibility at a lower cost of entry. That sounds good to us!

Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★★½

Time will tell if the 7350K finds its price sweet spot, but for now, it's a fun novelty that fills a gap.

★★★★½

$250 | WWW.ASROCK.COM

ASRock Z270 Extreme 4

Imitation is the sincerest form of flattery.

Let's just cut to the chase: the ASRock Z270 Extreme 4 has a bit of an identity problem. For any enthusiasts with their eye on the market, the Extreme 4 will look familiar to say the least. General wisdom states that imitation is the sincerest form of flattery, but in a marketplace with effectively only four manufacturers to choose from, for a quality tier-one motherboard product, the last thing we want to be seeing are copies of copies of copies.

To find a motherboard such as the Extreme 4 that so evidently takes cues from the previous generation MSI Xpower and ASUS Signature Series is disheartening.

Look and feel aside, the X270 Extreme 4 creates differentiation through unique specification, much like its stable mate the Gaming K6. As the only boards in the roundup to feature eight SATA3 6Gbps ports, the ASRock solutions utilise a combination of native PCH-based connections and an ASMedia ASM1061 hub to supply the additional two SATA ports. Aside from playing the quantity game in the SATA port department, the Extreme 4 delivered strong NVMe performance during testing, taking out the first place ribbon for the majority of NVMe-orientated storages tests.

Pairing the storage performance with good results in other areas, such as the Cinebench and *Far Cry Primal* tests, this budget-priced option appears attractive and perhaps a suitable pairing with the newly introduced Core i3-7350K.

Verdict

Aesthetically, it chants 'me too', but it can stand on its own merits in certain scenarios.

$280 | WWW.ASROCK.COM

ASRock Z270 Gaming K6

Tired, but perhaps not exhausted.

Gaming is the buzzword within the enthusiast segmentation of the PC industry, apparent in the abundance of 'gaming' products. This trend continues into the Z270 offerings with the majority of mobos in this roundup referencing gaming in one manner or another. The ASRock Gaming K6 follows all the tropes, but is it necessarily bad news to follow an established trend?

ASRock has delivered a competent product at a competitive price. However, it's not without feeling a little late to the party. With most other gaming offerings departing from the tired and worn-out aesthetic of red and black, the ASRock Gaming K6 clings to it and subsequently feels aesthetically worn out before even starting the race for your attention. Adding RGB elements to the mix merely further blurs the intentions for change versus regression as the potential lighting colours clash with the strong red forms.

Feature-wise, there are some elements of intrigue; for example, the additional two SATA3 6Gb/s ports to total eight, providing the two ports via an ASMedia hub chip combined with the six native ports provided by the Z270 PCH. Another intriguing inclusion is the third M.2 slot aimed at providing expansion for a wireless NIC.

Paired with strong NVMe storage performance and real-world gaming chops, it is the mix of usual with the unusual that make the ASRock Gaming K6 stand out and may potentially capture attention missed by eyes exhausted by the visual tropes.

Verdict

A budget-concious offering, but don't expect to use all features at once due to resource allocation.

$640 | WWW.ASUS.COM/AU

ASUS RoG Maximus IX Formula

So close to the mark, yet so far.

The Maximus Formula series is a stalwart of the Intel performance motherboard segment. Orientated towards gamers and overclockers alike, the series – now in its ninth iteration – has garnered a following based on a consistently deep feature set, technical expertise dashed with polish and aesthetic value. With these attributes has typically accompanied a premium price tag, which in the past has been able to be justified across the range of judging criteria.

Unfortunately, in this generation, it has become difficult to justify the price position of this unit. Part of the contributing factor for this difficulty is the strength of the competition within the marketplace and a glaring fault within the NVMe M.2 implementation incurred by the aesthetic intention of the design.

The Thermal Armour, supposedly designed to aid cooling efficiency, has hampered the NVMe performance, specifically sequential write performance, by inducing thermal throttling in the NVMe drive. NVMe sequential write with a Samsung 950 Pro should be approximately 1,500MB/s. Tests returned 1,260MB/s. Additional consecutive runs returned diminishing returns before bottoming out at 711MB/s – a poor showing from a performance product. Removing the shield covering the M.2 drive returned performance to the 1,500MB/s range.

It's an unfortunate misgiving, especially one with such a strong supporting software suite and beautiful hi-fi quality audio.

Verdict

A well featured board that's let down by form taking priority over function.

★★★☆☆

$410 | WWW.ASUS.COM/AU

ASUS TUF Z270 Mark 1

If it isn't broken, don't fix it.

Backed by a five-year warranty, the TUF series offers good value for money for PC enthusiasts operating on a longer upgrade cycle. With a focus on durability, quality componentry and rugged designs in both practical and aesthetic application, the TUF Z270 Mark 1 is built to endure and persevere.

Dropping the Sabertooth moniker previously held by the ATX form factor offering from the ASUS TUF range, this iteration can't help but feel like it has lost a little character. That's something this series of the ASUS offerings had in spades. With no mention of replacements of previous TUF entries such as the Gryphon and Vanguard, and perhaps a nod to a shrinking TUF range, the Z270 Mark 1 still delivers familiar ability with aplomb.

Producing strong performance results in CPU intensive benchmarks, such as 4K X265, Cinebench and the 3DMark physics sub-test, the TUF Z270 Mark 1 could be a fine choice for a Z-platform build destined to be a workhorse tasked with years of hard computational labour.

Featuring established longevity-focused TUF attributes such as Fortifier, ICe and Thermal Armour (not suffocating the NVMe M.2 this time), the TUF series, specifically this ATX implementation, has employed these and other longevity focused tricks for numerous generations to solid effect. It's, therefore, no surprise to see further iteration and exploration of these highlights.

Another commendable effort in the ASUS TUF range, this time in Z270 form.

Verdict

A well featured Z270 board that boasts the longest warranty on offer.

★★★★☆

$320 | WWW.GIGABYTE.COM.AU

Gigabyte Aorus Z270X-Gaming 5

The eagle has landed.

Introducing the Aorus brand to Gigabyte's gaming-orientated motherboard lineup, the Aorus Z270X-Gaming 5 puts a confident foot forward. Boasting an effectively muted, but not dull, visual appearance with well implemented RGB lighting highlights, the Aorus Z270X-Gaming 5 demonstrates maturity and sophistication mixed with lively intent and purpose.

Ensuring the new Aorus branding doesn't introduce all show with no go, the benchmark figures show the second highest total podium finishes across the scorecard. Excelling very well in the broad testing PCMark08 and highly intensive computational loads of Cinebench and the HWBot X265 benchmark, while consistently placing high across the rest of the benchmarking suite, it's hard to ignore the performance delivered by this well priced and featured motherboard.

As previously mentioned, the muted aesthetic palette brings to life the potential for individual flare through RGB lighting. The Gaming 5 is also the only motherboard in the roundup to feature an onboard RGBW header for external LED lighting that includes a white (W) channel. This is a positive specifically for those wanting to achieve bright colours or white light that can otherwise be washed out with hues of blue, purple and pink sneaking into what should be white light.

Packed with expansive storage solutions, including U.2 and SATA-Express along with the expected SATA and M.2, strong performance and convincing looks, the Aorus Z270X-Gaming 5 is not just a good foot forward but also one that lands with confidence.

Verdict

Swooping in on the competition with skill and grace. Pair with a 7700K for broadest usage.

★★★★½

$380 | WWW.GIGABYTE.COM.AU

Gigabyte Aorus Z270X-Gaming 7

Show and go to match.

The Aorus Z270X-Gaming 7 picks up where the Gaming 5 left off. With many of the same strong performance traits as its sibling, the Aorus Z270X-Gaming 7 provides additional features such as an improved audio solution and thunderbolt 3.0 connectivity for the price of a decent case of beer.

The feature sets deliver striking performance capability paired with enjoyable aesthetic appeal. The Gaming 7 adds a RGB LED element to the rear I/O shield which is otherwise absent on the Gaming 5, as well as additional onboard buttons for system tuning control, complete with audio switches to get the sound just right.

With the modders in mind, not just with the inclusion of the RGBW LED header, another interesting inclusion is the two-part rear I/O shield, allowing the I/O cover to be separated from the audio shield. This is good news for enthusiasts who prefer a more traditional visual with fully exposed VRM heatsinks. This look can be achieved without sacrificing the shield of the audio circuitry and delivering the full audio experience as planned from the engineer's blueprints to your ears.

The Aorus Z270X-Gaming 7 demonstrates robust performance across the PCMark08 test suite. Edged out by its sibling the Aorus Z270X-Gaming 5 within a small, almost insignificant margin, paired with adept performance at multi-threaded workloads as demonstrated in X265 and Cinebench, the Z270X-Gaming 7 could be a self up-sell option – but only if you *really* want.

Verdict

Hard to choose between the Aorus Gaming 5 and 7, but for a case of beer, this could decide for some.

★★★★½

$320 | AU.MSI.COM

MSI Z270 Gaming Pro Carbon

It has a McLaren on the box. It must go fast!

Entering the Z270 market with a thermally conductive M.2 shield, MSI's Z270 Gaming Pro Carbon proved to be a high performer in storage I/O tests. The platform, with the Gaming Pro Carbon at its heart, punched out some of the top I/O scores across the CrystalDiskMark 5 tests. In fact, of the 11 first-place results recorded on this mobo, 10 were directly related to the storage I/O – either SATA or NVMe M.2.

It's important to note that M.2 testing was done in the primary M.2 slot placed above the primary PCI-Express slot. This is the slot that does not utilise the M.2 shield; inferring that MSI have actually configured quite a fast storage solution on this motherboard. High performance carried over to the *Far Cry Primal* benchmark, securing second overall for the results achieved.

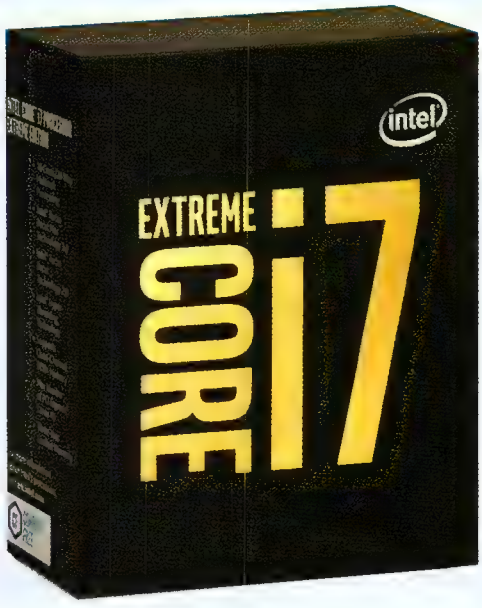
The visual treatment of the motherboard consists of a muted black, grey and silver theme, creating a great backdrop for the visual dynamics generated by the integrated RGB LED lighting across the board. Though some might find the attempt at replicating the pattern of carbon on the heatsinks potentially trying a little too hard, the general visual identity of this unit provides an appropriate background for RGB lighting expression and experimentation.

The only unit on test in this roundup with a single LAN port, some would argue that this is all that is needed. However, it is a matter of personal choice and potentially frees up motherboard resources to be allocated elsewhere more fitting to your need.

Verdict

A competent entry geared for storage I/O and gaming usage. Consider pairing with a 7600K.

★★★★½



Z or X platform – which do I need?

Intel splits its desktop-orientated market into two performance brackets; consumer desktop and high-end desktop (HEDT).

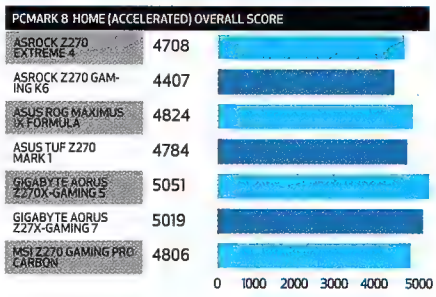
With this segregation also brings two desktop CPU variants designated by -S for the consumer platform and -E for the HEDT platform, with this suffix placed after the microarchitecture name. For example, Kaby Lake-S and Broadwell-E are the two current microarchitectures for the Z and X platforms respectively.

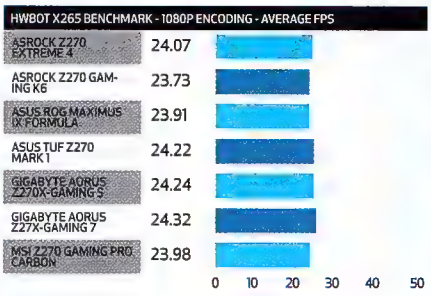
Architecturally, the two platforms are quite different. The X platform is thinly veiled server and workstation technology pushed into a high-performance desktop market segment. This product solution introduces server and workstation-grade technology like high core-count CPUs, currently topped by the Core i7 6950X Extreme Edition featuring 10 cores and 20 threads and starting with the Core i7 6800K featuring six cores and 12 threads. For memory implementation the HEDT X platform features quad channel memory for increased memory bandwidth ideal for the type of heavily multi-threaded workloads destined for the X platform. Additionally, the X platform features a significantly higher quantity of PCI Express resources, with a Core i7 6800K providing 28 lanes while there are 40 lanes available from the Core i7 6850K, 6900K and 6950X processors. This increased PCI Express resource allocation makes the X platform ideal for large 3- and 4-Way GPU configurations.

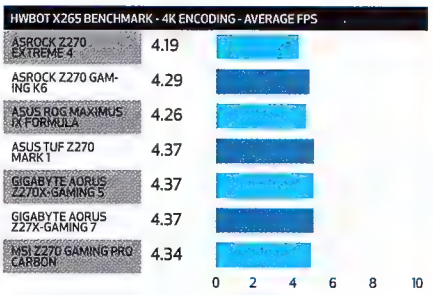
By contrast, the Z platform provides a consumer-orientated platform with CPU offerings bridging from the top of the line Core i7 through the Core range and eventually down to the Pentium and Celeron lines. These steps in segmentation will add or remove features; for example, hyperthreading, core count or cache memory density, depending on the target market. By comparison, Kaby Lake-S features 24 PCI Express lanes and dual channel memory — reduced resources on both fronts compared to the X platform. The Z platform typically supports 2-Way GPU configurations, with a PLX hub chip typically implemented to split physical PCI Express lanes to create a higher count of logical lanes to support the additional PCIe 16x slots for 3-Way or even 4-Way GPU configurations on a Z platform.

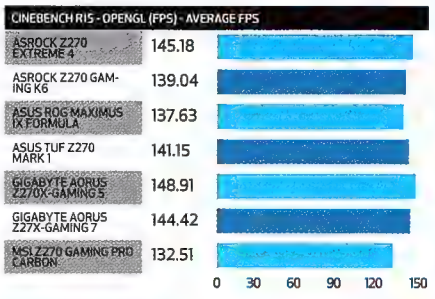
LABS BENCHMARK RESULTS

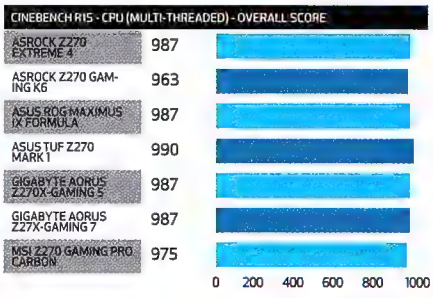
GENERAL & ENCODING PERFORMANCE

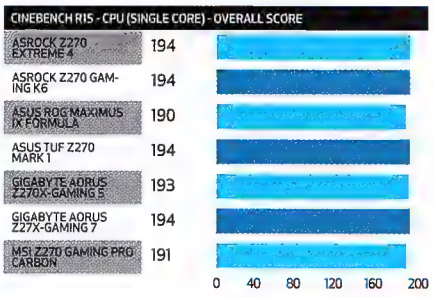

PCMARK 8 HOME (ACCELERATED) OVERALL SCORE
ASROCK Z270 EXTREME 4 4708
ASROCK Z270 GAMING K6 4407
ASUS ROG MAXIMUS IX FORMULA 4824
ASUS TUF Z270 MARK 1 4784
GIGABYTE AORUS Z270X-GAMING 5 5051
GIGABYTE AORUS Z27X-GAMING 7 5019
MSI Z270 GAMING PRO CARBON 4806
0 1000 2000 3000 4000 5000


HWBOT X265 BENCHMARK - 1080P ENCODING - AVERAGE FPS
ASROCK Z270 EXTREME 4 24.07
ASROCK Z270 GAMING K6 23.73
ASUS ROG MAXIMUS IX FORMULA 23.91
ASUS TUF Z270 MARK 1 24.22
GIGABYTE AORUS Z270X-GAMING 5 24.24
GIGABYTE AORUS Z27X-GAMING 7 24.32
MSI Z270 GAMING PRO CARBON 23.98
0 10 20 30 40 50

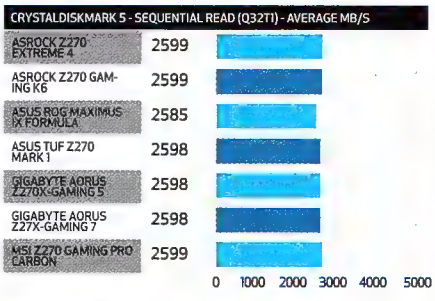

HWBOT X265 BENCHMARK - 4K ENCODING - AVERAGE FPS
ASROCK Z270 EXTREME 4 4.19
ASROCK Z270 GAMING K6 4.29
ASUS ROG MAXIMUS IX FORMULA 4.26
ASUS TUF Z270 MARK 1 4.37
GIGABYTE AORUS Z270X-GAMING 5 4.37
GIGABYTE AORUS Z27X-GAMING 7 4.37
MSI Z270 GAMING PRO CARBON 4.34
0 2 4 6 8 10


CINEBENCH R15 - OPENGL (FPS) - AVERAGE FPS
ASROCK Z270 EXTREME 4 145.18
ASROCK Z270 GAMING K6 139.04
ASUS ROG MAXIMUS IX FORMULA 137.63
ASUS TUF Z270 MARK 1 141.15
GIGABYTE AORUS Z270X-GAMING 5 148.91
GIGABYTE AORUS Z27X-GAMING 7 144.42
MSI Z270 GAMING PRO CARBON 132.51
0 30 60 90 120 150


CINEBENCH R15 - CPU (MULTI-THREADED) - OVERALL SCORE
ASROCK Z270 EXTREME 4 987
ASROCK Z270 GAMING K6 963
ASUS ROG MAXIMUS IX FORMULA 987
ASUS TUF Z270 MARK 1 990
GIGABYTE AORUS Z270X-GAMING 5 987
GIGABYTE AORUS Z27X-GAMING 7 987
MSI Z270 GAMING PRO CARBON 975
0 200 400 600 800 1000


CINEBENCH R15 - CPU (SINGLE CORE) - OVERALL SCORE
ASROCK Z270 EXTREME 4 194
ASROCK Z270 GAMING K6 194
ASUS ROG MAXIMUS IX FORMULA 190
ASUS TUF Z270 MARK 1 194
GIGABYTE AORUS Z270X-GAMING 5 193
GIGABYTE AORUS Z27X-GAMING 7 194
MSI Z270 GAMING PRO CARBON 191
0 40 80 120 160 200

STORAGE PERFORMANCE


CRYSTALDISKMARK 5 - SEQUENTIAL READ (Q32T1) - AVERAGE MB/S
ASROCK Z270 EXTREME 4 2599
ASROCK Z270 GAMING K6 2599
ASUS ROG MAXIMUS IX FORMULA 2585
ASUS TUF Z270 MARK 1 2598
GIGABYTE AORUS Z270X-GAMING 5 2598
GIGABYTE AORUS Z27X-GAMING 7 2598
MSI Z270 GAMING PRO CARBON 2599
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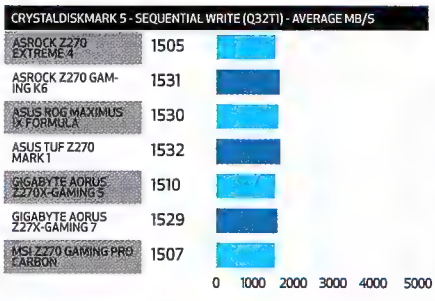
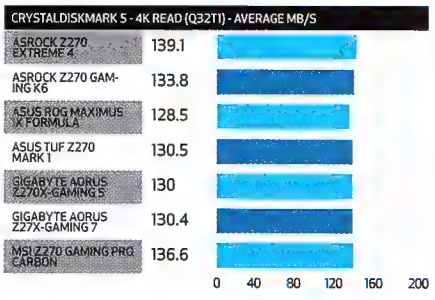
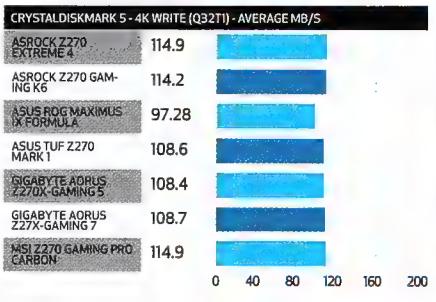
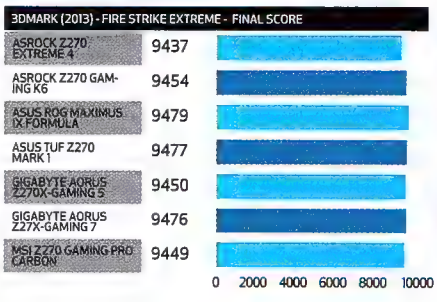

CRYSTALDISKMARK 5 - SEQUENTIAL WRITE (Q32T1) - AVERAGE MB/S
ASROCK Z270 EXTREME 4 1505
ASROCK Z270 GAMING K6 1531
ASUS ROG MAXIMUS IX FORMULA 1530
ASUS TUF Z270 MARK 1 1532
GIGABYTE AORUS Z270X-GAMING 5 1510
GIGABYTE AORUS Z27X-GAMING 7 1529
MSI Z270 GAMING PRO CARBON 1507
0 1000 2000 3000 4000 5000


CRYSTALDISKMARK 5 - 4K READ (Q32T1) - AVERAGE MB/S
ASROCK Z270 EXTREME 4 139.1
ASROCK Z270 GAMING K6 133.8
ASUS ROG MAXIMUS IX FORMULA 128.5
ASUS TUF Z270 MARK 1 130.5
GIGABYTE AORUS Z270X-GAMING 5 130
GIGABYTE AORUS Z27X-GAMING 7 130.4
MSI Z270 GAMING PRO CARBON 136.6
0 40 80 120 160 200


CRYSTALDISKMARK 5 - 4K WRITE (Q32T1) - AVERAGE MB/S
ASROCK Z270 EXTREME 4 114.9
ASROCK Z270 GAMING K6 114.2
ASUS ROG MAXIMUS IX FORMULA 97.28
ASUS TUF Z270 MARK 1 108.6
GIGABYTE AORUS Z270X-GAMING 5 108.4
GIGABYTE AORUS Z27X-GAMING 7 108.7
MSI Z270 GAMING PRO CARBON 114.9
0 40 80 120 160 200

GAMING PERFORMANCE


3DMARK (2013) - FIRE STRIKE EXTREME - FINAL SCORE
ASROCK Z270 EXTREME 4 9437
ASROCK Z270 GAMING K6 9454
ASUS ROG MAXIMUS IX FORMULA 9479
ASUS TUF Z270 MARK 1 9477
GIGABYTE AORUS Z270X-GAMING 5 9450
GIGABYTE AORUS Z27X-GAMING 7 9476
MSI Z270 GAMING PRO CARBON 9449
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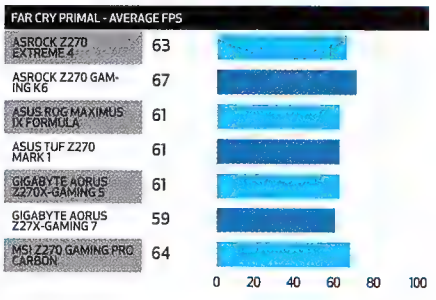
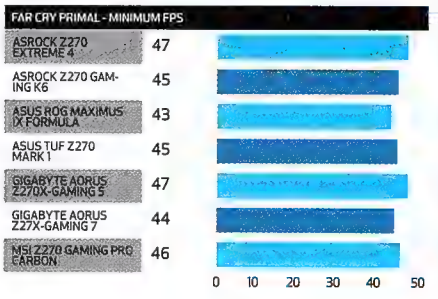
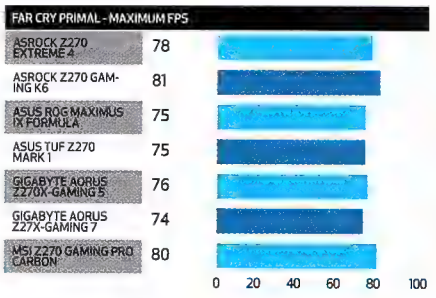

FAR CRY PRIMAL - AVERAGE FPS
ASROCK Z270 EXTREME 4 63
ASROCK Z270 GAMING K6 67
ASUS ROG MAXIMUS IX FORMULA 61
ASUS TUF Z270 MARK 1 61
GIGABYTE AORUS Z270X-GAMING 5 61
GIGABYTE AORUS Z27X-GAMING 7 59
MSI Z270 GAMING PRO CARBON 64
0 20 40 60 80 100


FAR CRY PRIMAL - MINIMUM FPS
ASROCK Z270 EXTREME 4 47
ASROCK Z270 GAMING K6 45
ASUS ROG MAXIMUS IX FORMULA 43
ASUS TUF Z270 MARK 1 45
GIGABYTE AORUS Z270X-GAMING 5 47
GIGABYTE AORUS Z27X-GAMING 7 44
MSI Z270 GAMING PRO CARBON 46
0 10 20 30 40 50


FAR CRY PRIMAL - MAXIMUM FPS
ASROCK Z270 EXTREME 4 78
ASROCK Z270 GAMING K6 81
ASUS ROG MAXIMUS IX FORMULA 75
ASUS TUF Z270 MARK 1 75
GIGABYTE AORUS Z270X-GAMING 5 76
GIGABYTE AORUS Z27X-GAMING 7 74
MSI Z270 GAMING PRO CARBON 80
0 20 40 60 80 100

TODAY'S BEST UPGRADES

WE REVEAL WHAT TO UPGRADE IN AN AGEING PC, AND WHEN TO DO IT.

The concept of the upgrade path is at the very core of the hardware enthusiast's philosophy. The notion that you can take a five-year-old system, throw out a few parts, install a few new ones, and have a rig up and running – which almost competes with a brand new build – in less time than it takes for Obama to drop the mic is certainly appealing. But how far does it go in practice? What makes the biggest difference? And what should you upgrade first?

This month, we decided to find out. We took two case studies, two rigs gathering dust in the corners of our office: one a gaming system, the other a workstation. And then we chose two very different upgrade paths for them both, just to see what makes the biggest difference to overall performance in their respective fields.

The first system was an ageing workstation. Featuring a mighty Core i7-970, this bad boy was Intel's second venture into six-core processors – and coming in at 3.2GHz and at about $1,000, it was no slouch. Coupled with a thwomping 6GB of DDR3-1600, a singular 2TB SATA II HDD and a powerful ATI Radeon HD 5870 graphics card, it was a monster in its heyday. Six years on, however, its hard drive is sluggish, the processor on a par with a modern Core i5 and its motherboard support is simply laughable.

In the other corner is our gaming rig. Far younger than its sibling workstation, this one had fared a bit better over the years. Featuring an Intel Core i5-4670, the Haswell monster still had plenty of computational power to muster – with 8GB of RAM, a 256GB OCZ Vertex 4 SSD and a reference GTX 670 pumping those frames, you could still game at 1080p, albeit far below the minimum desired rate of 30fps in most cases.

So if you're curious about what you should upgrade next and whether it's worth it, or you just want to take a look at what we did to bring these mature machines back to life, read on...

Practical advice for upgrading

There are plenty of reasons why we upgrade. They can range from the essential to the vain, from the aspirational to the vital. An upgrade may allow you to hit better frame rates in your favorite games, or give your system enough raw grunt to tackle a title that it couldn't before. If you use your machine for more serious work, an upgrade may allow you to get more done in a shorter space of time, or even do things that you wouldn't have been able to do with your current system.

A reasonable rule of thumb is: if you find yourself waiting for your machine to finish a task, then it could probably do with an upgrade. Whether that's rendering a video, applying an effect to an image, booting, loading an application or website – anything, really. Your time is precious, so don't squander it waiting. And it doesn't have to be a hardware upgrade that you need; turning to better software or tweaking the software you're already running could also be an option – but we'll come to that shortly.

Of course, there tends to be something holding most of us back when it comes to pulling the trigger on constantly upgrading, and that's the cost. Weighing up the benefits against the price tag is just as important as working out what those hardware updates should be. If your budget can extend to getting the very best component in each category, then all power to you, but most of us can't afford to maintain such an aggressive upgrade regime. If you know that you're going to have to change out several vital components, then planning your upgrade makes sense – buying a graphics card that will still be relevant when you change up your processor and motherboard later, for example.

Knowing what you want from an upgrade is key, because without that knowledge, you're just chasing the next biggest and brightest thing, without taking stock of whether it actually makes sense. Working out what you want to do also enables you to focus on the component or subsystem that will have the greatest impact.

For instance, we wouldn't normally recommend that you spend your time and money upgrading your memory, because for the vast majority of uses, 8GB is enough (or even 4GB, if you're dealing with a much older machine). However, if you're multitasking a lot, editing multiple 4K images and messing around with UHD video, then doubling up to 16GB or even 32GB could reap real benefits.

Processors

Your CPU is at the heart of pretty much everything you do, so there's a certain logic in coveting the very latest processor architecture, and seeing that as the magical panacea to all your computing woes. The problem with this train of thought is that more recent CPU upgrades have been fairly subtle in real terms. In fact, raw performance over the last few generations has increased by just 10%. So if you miss a generation, there's not too much to get upset about. Miss a few generations, though, and those figures add up (such increases are cumulative).

We haven't seen any major shift in core counts for mainstream processors, and the frequencies have been creeping up reasonably slowly as well. So even if your CPU is a few generations out of date, that's no guarantee that a CPU upgrade will transform your PC. Indeed, as we found in one of our case studies over the page, a decent CPU from quite a few years ago can still stand its ground against newer chips in practical terms.

There is a fairly major caveat here, though, which is that newer processors support newer technologies, aka the chipsets, and in terms of the bigger picture, this could make a CPU and motherboard upgrade a far more attractive option. M.2 NVMe drives, for instance, can hit transfer rates of 3.5GB/s, as opposed to a lowly SATA SSD, which sits at a meager 550MB/s.

Aim for a platform, and reap the benefits of the latest tech.

Upgrading your CPU isn't about buying the most expensive chip out there.

Graphics cards aren't just for playing games.

Graphics cards

If gaming is something that interests you, you need a graphics card. If you want to play the latest games, you need an up-to-date graphics card. That's pretty much the long and short of it. If gaming is lower down on your list, you probably don't need to upgrade — in fact, you might be able to get away with the integrated graphics capabilities of your CPU. As we say, knowing what you want to use your machine for is key.

As ever with graphics cards, you need to keep your target display in mind when looking at upgrades. There's not a lot of point dropping $950 on a GeForce GTX 1080 if you're happy with your standard HD display, and don't intend to upgrade it any time soon. Buy a graphics card that can drive your display(s), it's that simple. We run plenty of graphics card group tests to help you make the decision on what graphics card is right for you, but just as with the processor market at the moment, there's a good correlation between price and performance — if you're serious about gaming, spend as much as you can to get the performance you need for today's and tomorrow's titles.

Again, there's a proviso, which is to do with using a graphics card for more serious work. Some applications can take advantage of the processing power of a graphics card using CUDA or OpenCL to improve performance significantly — we're talking about the likes of Blender, Maya and Sony Vegas, among others. The problem is knowing which applications you use actually take advantage of which cards, using which API and, ultimately, to what benefit. Check out the software developer's website for the application you're utilising to see if there's any advantage to using a specific graphics card.

Storage

While processors and graphics cards get the most love in any upgrade decision, they're not the only areas of your system that you should be considering. In fact, we would suggest that another component should be the focus of your passions nowadays, and here we're talking about storage. If you're looking to make just one upgrade in your machine, then upgrading to a modern, speedy SSD will make a tangible difference to pretty much everything you do.

Yes, we know that it isn't traditionally the sexiest bit of computing, but the difference storage can make to how you use your machine can be as obvious as the difference between night and day. This is particularly relevant if you're rocking a spinning hard drive as your main boot device, but also true if you're going from a first- or second-generation SSD up to a modern NVMe M.2 drive. This, in turn, may require an upgrade to your system's motherboard, which could lead to a new processor, new memory and more, so as ever, it comes back to what you actually use your machine for.

Do yourself a favour — upgrade to a modern SSD.

There's still a place for spinning storage in modern PCs.

Case study: Gaming rig

So here she is, our upgraded gaming machine. From the get go, she came packed with a quad-core processor, 8GB of DDR3, a slightly ageing OCZ 256GB SSD, a 1TB hard drive, and the powerhouse that was the GTX 670. Boy, those were the days, huh? Not too old, we know. This machine was pieced together back in 2013, making it, relatively speaking, still fairly new. And it shows – the motherboard at the rig's heart is still sound. There's an M.2 slot offering up to 10Gbps transfers, plenty of PCIe slots for additional cards, support for up to 64GB of DDR3, and even onboard power buttons.

AIM OF THE UPGRADE

So the story behind this system was fairly simple. We assumed that the gamer in question was on a tight budget, they didn't have a lot of cash to throw around, and had only managed to save up for the occasional lump of hardware here and there since it had been originally built. The last and biggest bundle being the motherboard, processor and GPU combo.

The case was old, probably taken from an office PC from years ago, or a tower the grandparents had used for a while. The power supply was also old and the storage was somewhat wanting. So, ultimately, we kept it simple and just upgraded the memory capacity and the GPU. Upgrading from Nvidia's GeForce GTX 670 to the GTX 1060 would not only reduce the power draw overhead from the GPU, but also improve frame rates by well over 100%.

The Intel Core i5-4670K is by no means the bottleneck in this system – certainly not yet, anyway – but we decided to throw out the old memory in favour of something a little more impactful. So we grabbed two sticks of 8GB DDR3 to ensure that we could both game and run programs from the desktop without worry.

FREE UPGRADES?

There's a variety of things you can do to eke out extra performance here and there in a gaming build like this. Keeping your drivers up to date is essential if you want to improve performance. An unoptimised game can benefit by as much as 20–30%, purely from a driver pass. Couple that with a gentle GPU overclock, and you can easily crank those frames back up when you begin to experience problems.

Another cheap fix is to increase the number of fans in your build. GPU Boost 2.0 automatically increases the core clock of your graphics card, dependent on the overall temperature, so throwing a couple of extra fans in the front of a chassis, or even on a ventilated side panel, should help keep your card cooler, and let it overclock higher.

However, if you're concerned that your processor may be holding back your GPU, you can throw the multiplier up a fraction to see if that can alleviate the problem. If you're running a stock cooler, as we are here, we suggest leaving the voltage alone entirely, and adjusting the multiplier by two or three at most.

Double or nothing? Two GPUs can yield benefits, but they also increase your power draw.

CROSSFIRE CONUNDRUM

An alternative to purchasing a new GPU is to opt for a second older card instead, usually within one to two years of purchasing the first, if you can find one. This can be a good solution to save a few dollars, but it's not without its setbacks. Firstly, SLI and CrossFire profiles aren't always perfect. Generally speaking, on game launch, most titles simply don't have support for any multi-GPU configurations. Which means your second card immediately becomes a paperweight. On top of that, it's likely that you'll end up with trouble in the power supply department as well, if you're not careful, because you can easily add an additional 200W of power draw simply by adding the additional card. On the other hand, getting a more powerful card the first time around, or a newer generation of GPU, will lead you to guaranteed better performance and better power savings in the long run.

SPECIFICATIONS

	BASE	UPGRADES
PROCESSOR	INTEL CORE I5-4670K	
MEMORY	8GB (2 X 4GB) CORSAIR VENGEANCE DDR3 @ 1,600	16GB (2 X 8GB) CRUCIAL BALLISTIX TACTICAL 1600 ($150)
MOTHERBOARD	ASUS MAXIMUS VII HERO	
GPU	NVIDIA GEFORCE GTX 670 2GB	NVIDIA GEFORCE GTX 1060 6GB ($399)
STORAGE 1	256GB OCZ VERTEX 4	
STORAGE 2	1TB HITACHI 5,200RPM HDD	
COST		$549

1 CPU

Ultimately, we decided to forego upgrading the processor. The Intel Core i5-4670K inside this machine holds more than enough potential to handle any game or program we can throw at it. And if we really need to, we can swap out the cooler for something chunkier and crank those hertz up.

2 GPU

Swapping from a GTX 670 to a GTX 1060 made a whole world of difference. We opted to go for the 6GB reference variant in the end for this build, but the frame rate difference between that and the 3GB version really isn't catastrophic. We saw an overall increase of almost double in every game.

3 Memory

Upgrading from 8GB to 16GB of DDR3 for this build was purely a quality-of-life procedure. Having access to more memory gives us the opportunity to run VOIP clients, Google Chrome and recording software, all while running some of the more demanding AAA titles out there.

4 Hard Drives

All things considered, the storage situation was pretty sound from the start. A 256GB OCZ Vertex4 is still quite a competitive drive, and backed up by that 1TB drive, it covers all your bases. We would have loved to have changed to a PCIe drive, but for a gaming system, it's not entirely necessary.

The result

Well, it was always going to be a sure-fire victory for the GPU. The Intel Core i5-4670K is still an extremely competitive core. In fact, unless you're running anything pre-Sandy Bridge, you're unlikely to reach any bottlenecks with regard to gaming and graphical limitations. If this system was going to be sitting in the office for much longer, we would definitely take a look at swapping to a more modern chassis, and potentially go for a newer power supply and better cooling, too — just to reduce noise and for peace of mind. That said, this is a system more than capable of gaming at 1080p and beyond. Not bad for an outlay of about $550.

Benchmarks

ALL GAMES WERE TESTED AT THE MAXIMUM POSSIBLE PRESET, WITH HD TEXTURE PACKS TURNED ON. SCORES REPRESENT AVERAGE FRAMES PER SECOND IN THOSE TITLES, UNLESS OTHERWISE SPECIFIED.

	BASE SYSTEM	
CINEBENCH R15 (INDEX)	570	568 (0%)
AIDA64 MEMORY LATENCY (NS)	75.3	73.7 (2%)
CRYSTALDISK SEQUENTIAL READ (MB/S)	536	543 (1%)
CRYSTALDISK SEQUENTIAL WRITE (MB/S)	526	527 (0%)
3DMARK FIRE STRIKE (INDEX)	5,735	10,156 (77%)
FAR CRY PRIMAL (FPS)	35	66 (89%)
TOTAL WAR: ATTILA (FPS)	18	37 (106%)
RISE OF THE TOMB RAIDER (FPS)	20	40 (100%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Case study: Workstation

This is by far the more interesting build. In fact, its ancient and decaying spec sheet was still far more intriguing than the updates that followed. With one of the world's first six-core consumer processors, 6GB of DDR3 and a prestigious Intel motherboard (yep, it still made them), this system managed to crank out some serious numbers even today, six years on. The hard drive situation was far less desirable – with two SATA II HDDs, it was mostly used a web server, before finally being retired two years ago. Last week, it was a shelving unit. So what did we manage to salvage?

AIM OF THE UPGRADE

This was the biggy. We knew we wanted to upgrade to a more modern chipset. But a more modern chipset requires a brand new motherboard, and a new mobo requires a new processor, which requires new RAM. Like a cascade effect, upgrading one part meant that pretty much everything had to change. We opted to grab an Intel Core i7-5820K to replace the ageing Gulftown processor – it's cheap, packed with additional PCIe lanes for future upgrades and supports the latest X99 motherboards. Then we had to decide on the memory, upgrading from a tri-channel 6GB kit of DDR3 all the way up to a 32GB kit of quad-channel Crucial Ballistix Elite.

Motherboard-wise, we decided to go for the EVGA X99 Micro 2. It looks crisp and clean, it performs well, and it fits into our shiny new case well, too. On top of that, it gives us plenty of expandability going forward, enabling us to install two add-in cards if needed. We also fit a 240GB Kingston HyperX Predator M.2 PCIe SSD – not the fastest of the PCIe SSDs, but it's cost effective, and easily knocks the old SATA II drives out of the park.

FREE UPGRADES?

There are a couple of free options on a setup like this.

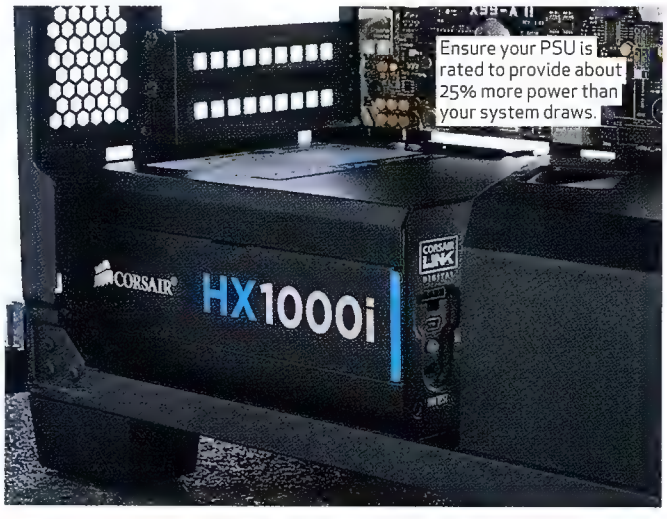
We took the old 2TB SATA II drives, and configured them to operate in RAID 0 to boost sequential read and write speeds. To do this, go into your motherboard's BIOS settings, find your SATA configuration panel, and change the storage type from AHCI to RAID. Upon restarting, hold Ctrl, and press I repeatedly to get into the RAID menu. Select the drives you want, choose the RAID setup you'd like, and create away. If you're using RAID 0, it should double your potential sequentials, and if you're using RAID 1, it mirrors the data on to the second drive, so if one drive fails, you always have an accessible backup.

Then there's overclocking. Far more useful for rendering tasks on workstations than on gaming PCs, bumping the Core i7-5820K up to 4.2GHz is relatively easy, and shaves off a significant amount of time from your render cycles.

PUMP UP THE PSU

For this build, we opted not to swap out the graphics card. As it's not gaming PC, but a content creation workstation, it was unnecessary to move away from a high-end card like the 5870 to something more modern, at least until we start using CUDA for rendering. That said, we had to consider that our operating requirements were going to change dramatically in contrast to the old Gulftown rig.

Using **pcpartpicker.com**, we specced up the requirements for our new upgraded system (including older GPUs and hard drives), which provided us with a good estimate of what our overall power usage was going to be (471W at peak). You should always look for a power supply that provides somewhere in the region of 20–25% more rated power than your system draws from the wall. That way, you'll never run it at max capacity, and PSUs are generally most efficient when they run at 80–90% capacity.



Ensure your PSU is rated to provide about 25% more power than your system draws.

SPECIFICATIONS

	BASE	UPGRADES
PROCESSOR	INTEL CORE I7-970	INTEL CORE I7-5820K ($599)
MEMORY	6GB (3 X 2GB) PATRIOT DDR3 @ 1,600MT/S	32GB (4 X 8GB) CRUCIAL BALLISTIX ELITE DDR4 @ 2,666MT/S ($329)
MOTHERBOARD	INTEL DESK BOARD	EVGA X99 MICRO 2 ($245)
GPU	ATI RADEON HD 5870	
STORAGE 1	2TB WESTERN DIGITAL SATA II	240GB KINGSTON HYPERX PREDATOR M.2 SSD ($219)
STORAGE 2	2TB WESTERN DIGITAL SATA II	
MISC		CASE, PSU, CPU COOLER ($500)
COST		$1,892

1 CPU

The CPU was the second-biggest change we made to this system. Jumping forward by five generations of processor technology has helped to push performance up by almost 35% in contrast to the Intel Core i7-970 that was originally found in this machine. A very worthwhile upgrade indeed.

2 Motherboard

And now the biggest change we made — the motherboard. Not only did we opt to go with an X99 board this time around, but we also swapped over to micro-ATX in the process. This means we can choose a smaller, more versatile chassis, yet still retain all of the power of the X99 socket.

3 Hard drives

Another massive change for our workstation is the upgrade from the ageing SATA II hard drive to the modern powerhouse of a PCIe SSD. Although it's not the fastest SSD drive out there, the HyperX positively warps space when you compare it to its spinning predecessor.

4 GPU

Simply put, this isn't a system for the gamers — it's a system for the designers, the CAD developers, the artists, the videographers and the photographers. An expensive GPU simply isn't necessary. Could it be used for gaming in the future? Of course, but for the time being, it's far from essential.

The result

As you can see from the benchmarks, the biggest performance increase stemmed from the hard drive swap. Going from SATA II drives to a PCIe SSD, and using the SATA drives as backup storage is nothing short of incredible. Interestingly, after five years of processor development, Intel's six-core enthusiast chip only beats the Intel Core i7-970 by 35%. What's important to note is that the price has plummeted. Other than that, this upgrade came together nicely. The HD5870 was still more than enough for all the editing we wanted to do. In the long term, however, it might have been nice to change out to a GTX 1060 or RX 480 instead.

Benchmarks

ALL BENCHMARKS ARE RUN THREE TIMES FOR CONSISTENCY AND AN AVERAGE IS TAKEN. AND YES, CRYSTALDISKMARK SCORES ARE CORRECT.

	BASE SYSTEM	
CINEBENCH R15 (INDEX)	750	1016 (35%)
AIDA64 MEMORY LATENCY (NS)	70.5	70.6 (0%)
CRYSTALDISK SEQUENTIAL READ (MB/S)	132	1,573 (1,092%)
CRYSTALDISK SEQUENTIAL WRITE (MB/S)	131	995 (660%)
CRYSTALDISK 4K READ (MB/S)	0.7	37 (5,185%)
CRYSTALDISK 4K WRITE (MB/S)	1.2	103.7 (8,542%)
PCMARK 8 HOME (INDEX)	3,249	3,937 (21%)
3DMARK FIRE STRIKE (INDEX)	2,837	2,844 (0%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Other tweaks and tricks

Chassis are slowly turning into works of art.

Cases

You could say a case is nothing more than six panels of metal holding the components of a system together. In reality, it's much more than that. Cases are an essential part of PC building. Whether you build your own, pinch one from an age gone by, or go all-out and purchase a $500 affair, it's something that every PC user has. But how much of an impact does it make in the world of upgrades? Is it worth upgrading at all? That depends on what you have. There are a few examples where swapping out to a newer chassis provides you with more performance.

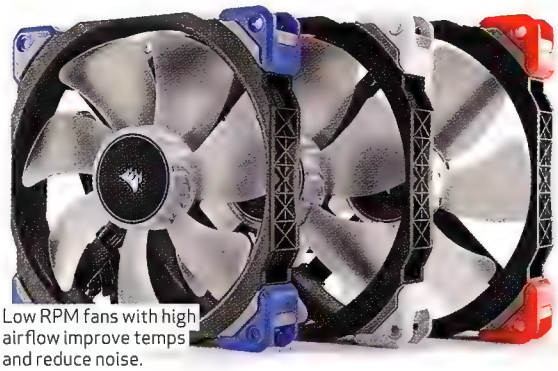
Graphics cards from AMD and Nvidia come with a new form of technology known as GPU Boost. This is an auto-overclocking feature that increases or decreases the core clock speed, dependent on the card's temperature. Depending on the size of your case and the amount airflow, you can affect the temperature of hardware inside. It's why blower fans and dual and triple dissipation card designs exist. Blowers can draw in vast quantities of air from a single vent hole, while the dissipation variety spreads the hot air around the chassis. If you're not providing enough cool air inside a chassis, you'll likely cripple your graphics card's overall performance.

On top of that, there's the ease of access of newer cases, with multiple 2.5-inch drives, better cable management, improved airflow, and support for a wider variety of cooling, motherboards, form factors and more. So upgrading your chassis can be very satisfying.

Cooling

Speaking of cooling, it's always a good idea to evaluate your situation. Ambient temperatures are always going to have a dramatic effect on overall internal temperatures. For instance, if you're stuck in Darwin without aircon, your rig may very easily run at 10 degrees (or more) higher than, say, someone sitting in Tasmania. With that being the case, you're going to need more efficient forms of cooling than a reference stock cooler to avoid thermals throttling your hardware. You can check a lot of this by running a few simple benchmarks, such as Prime95 and Unity's Heaven, alongside HW Monitor, to register just what temperatures your hardware is running at.

There are multiple ways you can help alleviate the throttling situation. Swapping out a reference CPU cooler for something more efficient, such as Cooler Master's Hyper 212 Evo, will help ensure your processor doesn't overheat far better than any stock cooler, and for $50, that's not a bad deal. We also suggest you run at least two intake fans in your chassis to provide sufficient airflow internally, to keep all your components well fed.


Low RPM fans with high airflow improve temps and reduce noise.

If you're thinking about overclocking to boost those performance figures some more, we would suggest you take a look at watercooling, especially when it comes to Intel's latest chips. You don't need something like a custom loop, but a single 120mm AIO liquid cooler, such as the NZXT Kraken X42 or Corsair Hydro H60i, will provide you with ample capacity to overclock most processors.

Memory

As DDR4 replaced DDR3 with the introduction of the X99 and Z170 chipsets, it failed to impress many hardware reviewers, purely because it added little to performance figures. Indeed, memory speeds seem inconsequential for the vast majority of users.

Improved capacities and lower power draw, though, mean we're seeing overall wattage requirements plummet. And if you want to upgrade your memory, we recommend you choose capacity over speed, and get the capacity you need: 8–16GB for gaming and everyday tasks; 16–64GB for video rendering and 3D modeling. Speed isn't a necessity.

DDR4 performance increases are negligible, but with increased capacity, it's a no-brainer.

Graphics cards aren't just for playing games.

Monitors

If you're not into gaming, upgrading your screen is a relatively painless affair. For professionals and graphic designers, the obvious route is to grab yourself one of those swanky IPS panels. Providing far better colour reproduction, IPS and PLS are exceptionally useful for those looking for colour accuracy from screen to printer. On top of that, there's the argument of resolution and screen real estate. Bumping up the size of your screen in conjunction with resolution, to maintain your pixel-per-inch ratio while also increasing screen real estate, makes it far easier to work on multiple programs at the same time. Going from a 24-inch 1080p screen to a 27-inch 1440p screen is a joy, and well worth the time of day.

That said, on the other side of the fence, for gaming, it's a little more complex. Your screen choice is inherently symbiotically joined at the knee with your GPU. Choosing the right screen is dependent on what graphics card you have, what games you play and what resolution you want to achieve. Working backward, if you're looking at gaming at 1080p, the RX 480 or GTX 1060 is a fine combination; at 1440p, the GTX 1070 or Fury X is a perfect solution; for 4K, you can almost get away with a GTX 1080 with some lower AA settings. For high refresh rates at 1440p, the GTX 1080 is the king.

Motherboards

Motherboards are by far one of the most underappreciated components in any given system. And it's not hard to understand why, either. Marketing gurus throughout the industry have been promoting these "performance-enhancing pillars of computing" for quite some time. If it's not Killer Networking touting a whole 200ns faster speeds than its Intel rivals, it's efficient capacitors, gaming technologies, and whatever else the whizz-kids want to slap on to each box to bump up the price tag.

That said, once you've waded through the mire of marketing sludge, and got to the grunt of what makes Intel's constant chipset updates more interesting than most, the whole concept is actually more intriguing than you would first think.

It's the enhanced connectivity that really sells it. Take a look at Z170 compared to the previous generation's Z97 chipset, and you'll see what we mean. Each generation sees improved support for a wide variety of connection standards. M.2 SSDs, which were so rare two years ago, are now commonplace, providing read and write speeds up to six times faster than any SATA SSD, and Intel accommodated for that.

Marketing spiel aside, higher-priced motherboards generally tend to feature improved onboard audio, alongside more efficient VRMs, meaning you can operate higher overclocks and low undervolts on your system with ease.

Chipset is still king.

CHIPSET ADVANCEMENTS

	INTEL Z97 CHIPSET	INTEL Z170 CHIPSET
PCI LANES	8X PCIE 2.0 @ 5GB/S	20X PCIE 3.0 @ 8GB/S
USB 3.0 PORTS	6	10
USB 2.0 PORTS	14	14
SATA PORTS	6	6
DMI	2.0	3.0
DDR SUPPORT	DDR3 @ 1,600	DDR4/DDR3L @ 2,133/1,600

GRASPING THE BLOCK CHAIN

IT'S THE BUZZWORD PROMISING TO DISRUPT EVERYTHING FROM FINANCIAL MARKETS TO THE WAY WE VOTE, BUT WHAT IS A 'BLOCKCHAIN' AND WHAT DOES IT DO?

LAUREN TATE

Bitcoin was the first digital currency to use blockchain technology.

Over the last 20 years, the internet has gone from an office curiosity for sending emails and downloading shareware software, to all but running the global economy. In fact, it's become such an economic driver, a recent PricewaterhouseCoopers report estimates that connecting the world's remaining four billion people not yet on the internet could add as much as US$6.7 trillion to the global economy (tinyurl.com/apc437-economy).

But while the internet has spawned a new globally-connected economy, it's also attracted its fair share of crooks. According to the Australian Cybercrime Online Reporting Network (ACORN), more than $127 million was reported lost by Australian consumers to online scams in 2015 (**tinyurl.com/apc437-scam**). Australian businesses don't appear to be faring much better with PricewaterhouseCoopers' recent 2016 Global Economic Crime Survey suggesting Australia has become a hotspot for cybercrime. In the report, 65% of businesses surveyed reported cybercrime over the previous two years, double the global average (**tinyurl.com/apc437-crime**).

And not even central banks are immune – not after the hacking of the Bangladesh Bank in February netted thieves some US$81 million through fake inter-bank money transfers. According to reports, the only thing that stopped the crooks from nabbing a massive US$1 billion haul was the lack of a spell-checker (**tinyurl.com/apc437-heist**).

But there's a technology that underpins new digital or 'crypto' currencies like Bitcoin that not only has the potential to slash banking costs, it could disrupt much of the financial sector and even revolutionise the way we vote in general elections. It's called 'blockchain' and you'll be hearing more of it in the years to come.

CRYPTOCURRENCY ORIGINS

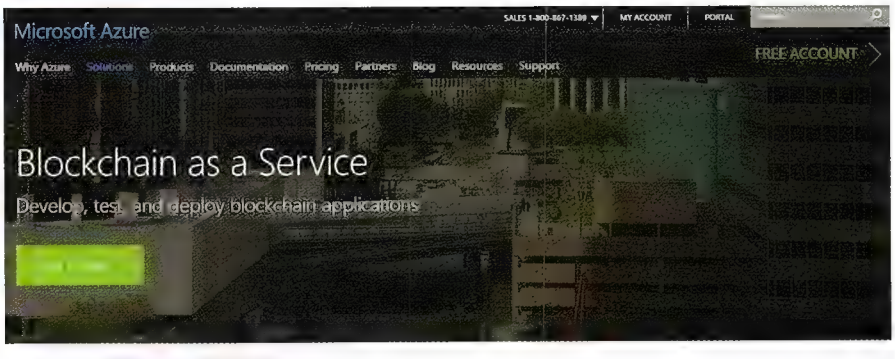
Cryptocurrencies have enjoyed a high profile in geek circles since the 2009 launch of Bitcoin and dozens of variations since. But while digital currencies can be either deflationary (only a fixed number of coins can be produced, like Bitcoin and Litecoin) or inflationary (no limits on currency production, like Peercoin and Dogecoin), they all invariably use a unique method of storing the currency's transaction histories.

Transactions between banks typically take place through a central register or clearing house, ensuring that each dollar is accounted for. But the developer(s) of Bitcoin (just who created Bitcoin is up for debate) went the other way – they chose an open system of networked or 'distributed' ledgers or databases called the 'blockchain' to keep track of every Bitcoin transaction. Think something along the lines of 'peer-to-peer networking' and you're on the right track. But what's more, the system's checks and balances, combined with the peer-to-peer decentralisation used to protect the blockchain, ensure that no one person can take control of it – at least in theory. These days, reports are as much as 80% of bitcoin processing activity or 'mining' occurs in four main mining groups or 'pools' in China (**tinyurl.com/apc437-bitcoin**).

WHAT IS THE BLOCKCHAIN?

Bitcoin explains the blockchain as a 'shared public ledger' that keeps track of and proves 'who owns what' when it comes to bitcoins. Any time a bitcoin is spent, a transaction is created, logging essential details such as the spender, the receiver and the bitcoin amount spent. But to ensure its legitimacy, the transaction itself is digitally encoded with a secret signature called a 'private key', which is kept in the user's Bitcoin wallet, along with their bitcoins. It generally takes ten minutes for the system to confirm a transaction but, once confirmed, it is then added to a 'block'. These blocks are linked chronologically to maintain the system's consistency and integrity, creating a chain of blocks, which becomes the 'blockchain' (**bitcoin.org/en/how-it-works**).

What makes cryptocurrencies like Bitcoin unique is that anyone can set up and begin processing these transactions to continue the

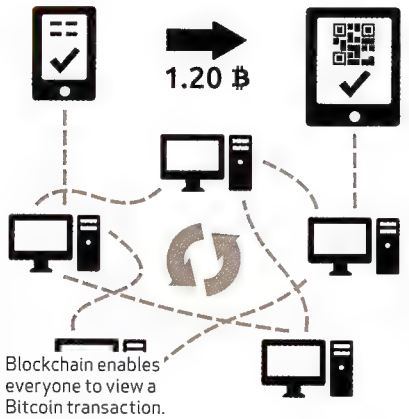


Blockchain-as-a-service is the latest product offering from Microsoft.

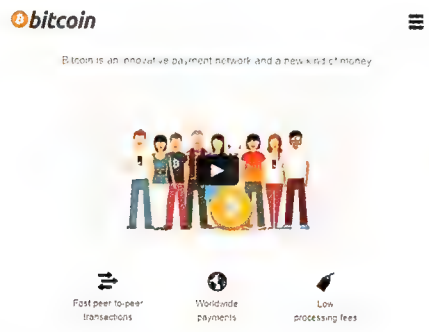
What is blockchain?

Blockchain is an emerging way for businesses, industries, and public organizations to almost instantaneously make and verify transactions—streamlining business processes, saving money, and reducing the potential for fraud. At its core, a blockchain is a data structure that's used to create a digital transaction ledger that, instead of resting with a single provider, is shared among a distributed network of computers.

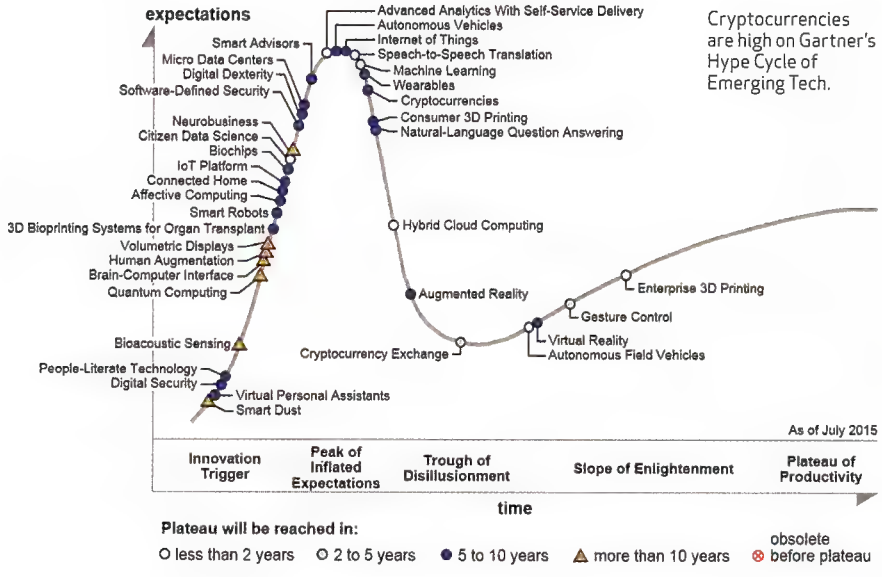
The result is a more open, transparent, and publically verifiable system that will fundamentally change the way we think about exchanging value and assets, enforcing contracts, and sharing data across industries. The applications using blockchain are almost limitless, ranging from loans, bonds, and payments to more efficient supply chains to even identity management and verification.



Blockchain enables everyone to view a Bitcoin transaction.



Anyone can mine bitcoins but it now requires specialised hardware.



Cryptocurrencies are high on Gartner's Hype Cycle of Emerging Tech.

blockchain, a process called Bitcoin 'mining'. You may have heard of geeks setting up banks of computers to 'mine bitcoins' for profit – they're not mining actual currency, but rather, they're processing or confirming these transactions and receiving a fee in bitcoins for their work. In addition, bitcoins can also be obtained through traditional currency exchange. The other important thing is that the Bitcoin blockchain is accessible to anyone. That's because, once the blockchain is written, the system's cryptographic and peer-to-peer nature means it's all but impossible to change it, making it a permanent record.

WHY BANKS ARE INTERESTED

Governments and financial institutions are mostly lukewarm on the idea of cryptocurrencies, but enthusiasm amongst leading global financial players for blockchain technology appears to be spreading at bushfire-speed.

While early reports suggest blockchain is separating the top-tier institutions from the smaller players, the technology is seen as a way of slashing the cost and time of clearing inter-bank transactions, as well as creating a more secure system. At the moment, the situation seems to mirror many previous new technology arrivals, with stakeholders scrambling to form new alliances to commercialise blockchain technology (think 'VHS vs Beta' of the mid-1980s). The most significant of these alliances so far from an Australian perspective is the R3 consortium (**r3cev.com**), which includes three of Australia's 'big four' local banks – Westpac, Commonwealth and NAB – as well as more than 40 other banks and financial institutions around the world.

Testing of the technology is well underway, with the Commonwealth Bank and 10 other global banks setting up a blockchain trading simulation in January 2016 with Microsoft's Azure enterprise cloud-storage playing host (**tinyurl.com/apc437-commbank**). That was followed in March by a much larger trial involving R3 members testing a range of blockchain technology providers including IBM, Intel and Ethereum (**tinyurl.com/apc437-trial**). And to give you an idea of just how fast things are moving, the R3 group decided the following month that it was ready to jump aboard the Microsoft bandwagon and ink a deal that will likely cement the software giant as a leading player in blockchain services.

EVERYTHING AS A SERVICE

Blockchain competition amongst the tech giants is growing rapidly. The days of making squillions from selling computer hardware to corporations are fading fast – these days, the big money comes from selling products as services, thanks mostly to distributed or 'cloud' computing. You may have already heard of 'software as a service' (SaaS), such as your Office 365 online subscription. But there's also 'infrastructure as a service' (IaaS), where tech companies supply virtual hardware over the internet and care for enterprise-scale servers running many corporations.

But showing that you can seemingly make almost anything a service, Microsoft is now selling 'blockchain as a service' (BaaS), offering to play host to blockchain ledgers not just for banking but for "businesses, industries and public organisations". IBM and Amazon are also revving up their cloud computing reserves to deliver blockchain services. Meanwhile, chip giant Intel has announced its own distributed ledger technology codenamed 'Sawtooth Lake' in support of the Linux Foundation's HyperLedger Project (**tinyurl.com/apc437-intel**), of which Australia's ANZ Bank is a member.

POTENTIAL JOB LOSSES

But even before blockchain technology has clocked on for its first shift, there is talk that the rise in new financial technology or 'fintech' could lead to significant job losses within the financial services sector. A report from Citigroup released at the end of March this year forecasts as many as 1.7 million jobs could be lost to disruptive technology changes within the industry in the US and Europe over the next 10 years – equating to 30% of the current industry workforce. Report author Ronit Ghose is quoted as saying that "the biggest take out [of jobs] will happen in countries that have been through a crisis or are tech savvy". Those job losses are expected to come from the continued move from face-to-face to online banking, as well as implementing cost-cutting technology such as blockchain (**tinyurl.com/zkwjwrv**). At time of writing, no-one had put a number on the potential job losses in Australia, although it would be unrealistic to think the local industry will be immune.

OVER-HYPED?

According to market analyst Gartner, cryptocurrencies in general remain high on its 2015 Hype Cycle for Emerging Technologies. CEO of financial services firm JP Morgan, Jamie Dimon, reportedly believes cryptocurrencies like Bitcoin will struggle in the face of government controls (**tinyurl.com/apc437-jpmorg**).

What's more, not everyone shares the view that blockchain will set the world alight. While many, Dimon included, acknowledge the potential of blockchain technology, others question the role it will play in the financial industry. The European Central Bank published a paper in April this year on 'distributed ledger technology' (**tinyurl.com/zog95du**, PDF), concluding that, while blockchain has potential, questions over whether it can make the leap to mainstream financial markets mean "it is more likely to cause a gradual change in processes, rather than a revolution in the market".

ELECTRONIC VOTING

But it's not just the financial sector feeling the blockchain blowtorch – it's even being touted as a solution for e-voting. The recent closely-fought federal election in Australia saw many call for the introduction of electronic voting. The expectation is that e-voting will speed up vote-counting and the declaration of seat winners, but also reduce waiting times for voters at the polling booths. Not only has Prime Minister Malcolm Turnbull thrown his support behind it, so too have academics, including the Director of University of Western Australia's Centre for Software Practice.

However, within government circles, e-voting has generally been considered fraught with complications, not least of these being privacy and security. Various Australian Government inquiries have looked at electronic voting since 2000, when a small delegation from the Australian Electoral Commission (AEC) headed to the US to witness e-voting during the then US presidential election. The following year, the AEC itself produced a report into e-voting, noting the major advantages, including instantaneous calculating of results and the ability for any voter to vote anywhere in the country. But it also outlined the disadvantages, from cost of computer hardware needed at each polling station to the lack of a paper trail of ballots, potentially raising "unacceptable risks" (**www.aec.gov.au/voting/report.htm**).

More recently, the second interim report of the parliamentary inquiry into the conduct of the 2013 federal election investigated options for e-voting. It noted that the main concerns were the security, integrity and transparency of the system, along with cost and the system's ability to maintain vote secrecy and engender voter confidence (**tinyurl.com/apc437-report**). The final report of the 2013 election concluded in its introduction that "to introduce large-scale electronic voting in the near future would dangerously compromise federal electoral integrity" (**tinyurl.com/apc437-final**).

Read online forums and you'll find responses to the idea of e-voting range from enthusiasm to acceptance, caution to suspicion. As some argue, the fact that we still scrawl markings on sheets of paper makes our voting system robust and much more difficult to hack, as multiple scrutineers check the counting of each vote. In the end, it might be slow and labourious, but it's considered accurate and trustworthy.

AUSSIE START-UPS

However, blockchain transactions are considered extremely difficult to hack, they remain forever and can be viewed by anyone, which means blockchain could solve the problem of waiting for weeks for an election outcome.

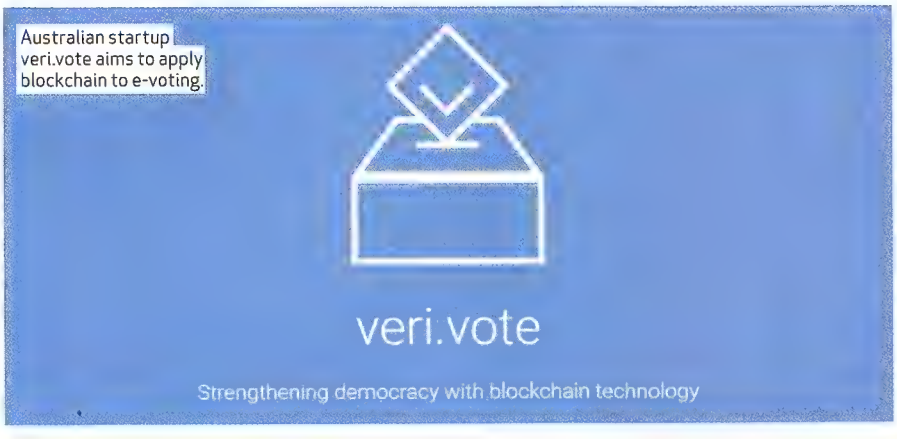
Perth-based veri.vote (**veri.vote**) is one Australian startup in the race against teams from the US to deliver e-voting technology based on blockchain storage. According to its website, veri.vote is aiming for a system that is efficient in resources, secured through blockchain technology, completely anonymous and uses open-source software and protocols to allow anyone to view an election result.

Still, there are many questions that remain unanswered about how e-voting would work in practice, from vote-taking to vote-counting to vote verification processes that ensure computers don't muck things up.

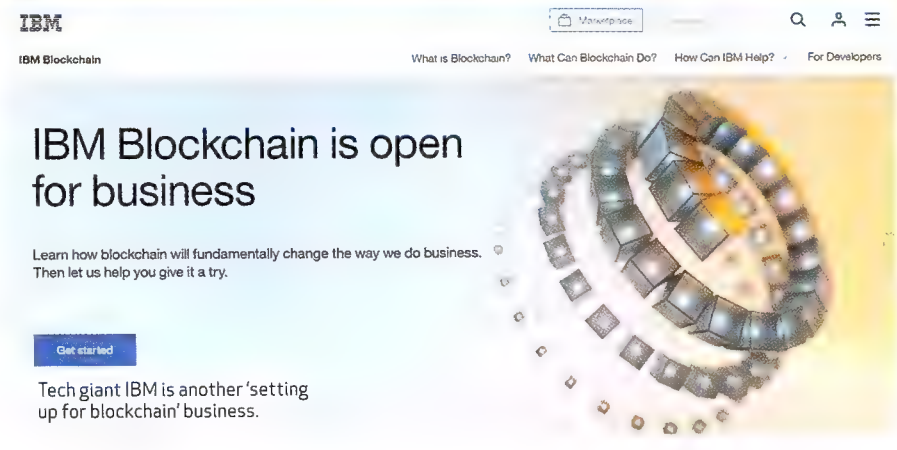
Then there's protecting voter anonymity, something enshrined in Australian electoral laws. We suspect it'll take a bit more than just someone from the AEC or government of the day coming out and saying that e-voting is perfectly anonymous to convince voters. Acceptance may even come down along generational lines, with younger 'digital-native' voters possibly more likely to accept e-voting than older voters.

SECURING THE FUTURE?

Blockchain is viewed as having real potential for solving some of the internet's greatest security and privacy concerns – from financial transactions to electronic voting. But it's very early days, and while testing is progressing, blockchain still has a long way to go before its running global banking and democratic elections. That's reason enough for us to keep a lid on expectations for a little while yet.


Australian startup veri.vote aims to apply blockchain to e-voting.
veri.vote
Strengthening democracy with blockchain technology

Australian startup veri.vote aims to apply blockchain to e-voting.


IBM
IBM Blockchain
What is Blockchain?
What Can Blockchain Do?
How Can IBM Help?
For Developers
IBM Blockchain is open for business
Learn how blockchain will fundamentally change the way we do business. Then let us help you give it a try.
Get started

Tech giant IBM is another 'setting up for blockchain' business.

how to

» QUICK TIPS

Experts solve your computing problems

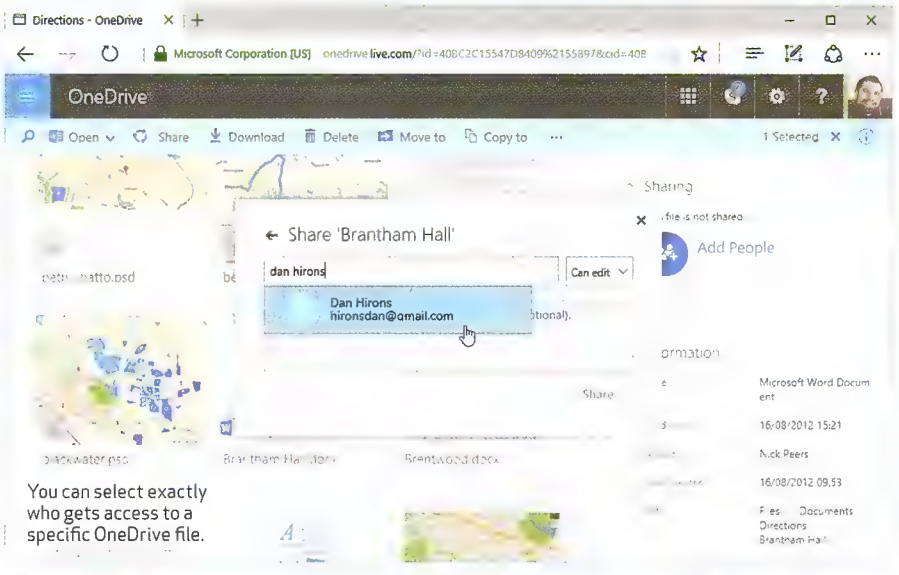
APC and its readers can be one giant helpdesk. If you have a technical problem, chances are one of us can solve it.

STORAGE

ONEDRIVE SHARING QUANDARY

I'm trying to find a way of sharing one of my OneDrive folders with a family member, but am struggling to get things set up. What's the best way to do this?
Colin Lester

The obvious way is to open OneDrive in your web browser and share through the web interface, but if you're running Windows 10, then the good news is that you can create a shared link from within Windows itself. Simply navigate to the folder inside your OneDrive folder you wish to share, then right-click it. You'll see a number of OneDrive-related options — choose 'Share a OneDrive Link' and a web link will be created and sent to your clipboard (Windows should notify you of this). Simply paste this link in an email and the recipient will be able to access the shared folder. If you want more granular control over the folder you share, such as sharing it with specific people, choose 'More OneDrive sharing options'. This will open your web browser — choose 'Manage permissions' when it pops up and you'll be able to choose exactly who has access to the file or folder, and whether that access is read-only or editable.
Graham Barlow



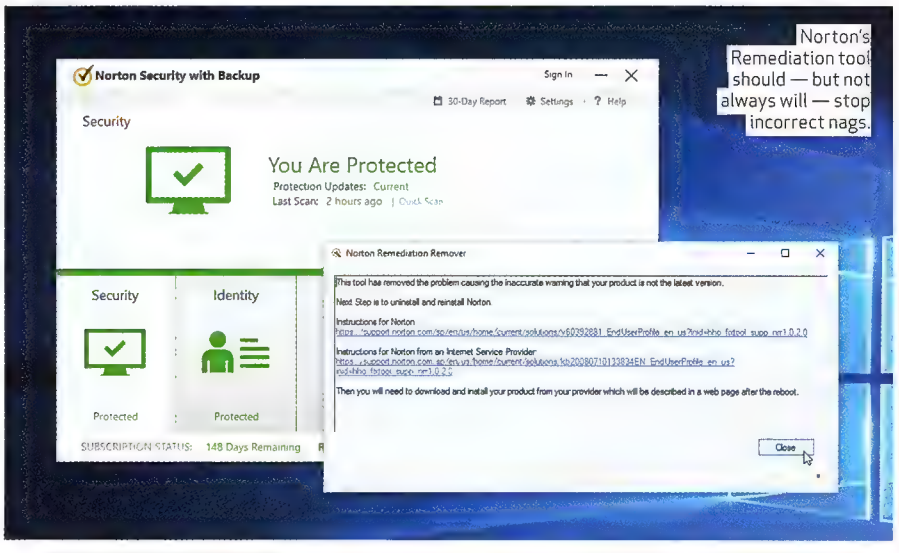
You can select exactly who gets access to a specific OneDrive file.

SECURITY

NORTON RETURNS

When I upgraded to Windows 10 a while back, I also removed the Norton Security suite — because I've never used it — when upgrading to the new OS. Now I keep getting the Norton Downloader tool popping up on a regular basis telling me I need to update. I've deleted it five or six times, but it keeps coming back.
David Wood

First, we instructed Dave to try running the Norton Remediation Remover tool (**bit.ly/nortonrr**), but after a week, Norton came back again. We rooted out various known files and removed them, and Dave even tried installing Norton as directed before removing it, all to no avail. He eventually chose the Symantec Chat option, and a technician removed a number of files that allegedly fixed the problem. But once again, within a week, the prompt had returned. At this point, we wondered what else on David's system might be causing the problem — it's possible a third-party tool was checking for the presence of Norton, then re-downloading the files. As a final suggestion, we asked David to consider performing a clean install of Windows 10 to scrub all possible files from the system. We hope this finally fixes it!
Graham Barlow



Norton's Remediation tool should — but not always will — stop incorrect nags.

HARDWARE

I (CAN'T) SEE RED

I have two PCs connected to a single monitor, but while one works perfectly, the other (an Acer desktop) is giving me a colour problem. I can't seem to get the red to display, and have tried many things in Windows, so am I right to assume the graphics card is the issue and needs replacing?
Harold Tokins

While it's tempting to point the finger at hardware failure, there are some

Checking that the cables connecting your monitor and PC are fully inserted is a good first step to diagnosing strange image problems.

additional checks you need to perform before replacing the card. First, check the problem isn't with the connection – both the cable connecting your PC and the connector on the monitor itself. Harold revealed the PCs were sharing the same monitor input via a Belkin crossover switch. He reconnected the plugs and immediately discovered his affected PC was now showing far too much red – tweaking the settings back to normal using the Nvidia Control Panel restored the display to its correct settings, and saved him the unnecessary cost of a graphics card replacement.

Nick Peers

SOFTWARE

CRACKING IN TO WINDOWS 10'S SAFE MODE

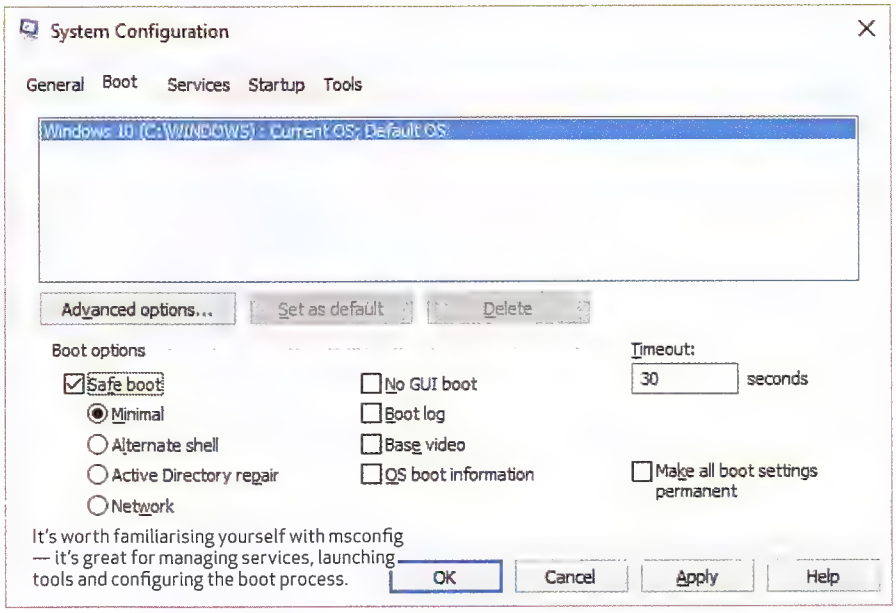
I seem to recall that APC has mentioned there's some special way you need to access a Windows 10 boot menu if you want to enter Safe Mode. Would it be possible for you to send me the directions? I know it had something to do with pressing the Shift or Alt key before or during the reboot process, but I can't remember the exact instructions, nor can I find the issue of APC where I think I saw them. Please assist with this one!

Carl Smith

There are a few ways to get into Safe Mode. The one you're probably referring to involves opening the 'Start' menu, clicking 'Power' and then selecting 'Restart' with the Shift key held down. Your PC should then reboot to a screen that asks you to choose an option: Continue, Troubleshoot or 'Turn off your PC'. Click Troubleshoot, then 'Advanced options' and finally 'Startup Settings' (yes, we know, this is way more convoluted than it needs to be). From there, click 'Restart'. The operating system restarts and you're given several options, three of which include Safe Mode. Pick the one most appropriate to your situation, and you're on your way.

Alternatively, you can right-click the Windows button, click 'Run', and enter `msconfig` . Click the Boot tab, and check 'Safe boot'. Click OK and Windows prompts you to restart, kicking you into Safe Mode. Should something go awry, preventing you from booting up normally, it's good to have a recovery drive handy. Use the Windows search feature to find the 'Create a recovery drive' program. Make sure 'Back up system files to the recovery drive' is checked, and click Next. Connect an 8GB or larger flash drive, click Next, then Create. From there, you can boot to Safe Mode (make sure your motherboard's boot priority has USB above SATA- or PCIe-based storage) by choosing a keyboard layout, and picking 'Troubleshoot > Advanced Options > Startup Settings > Restart'.

APC team



NETWORKING

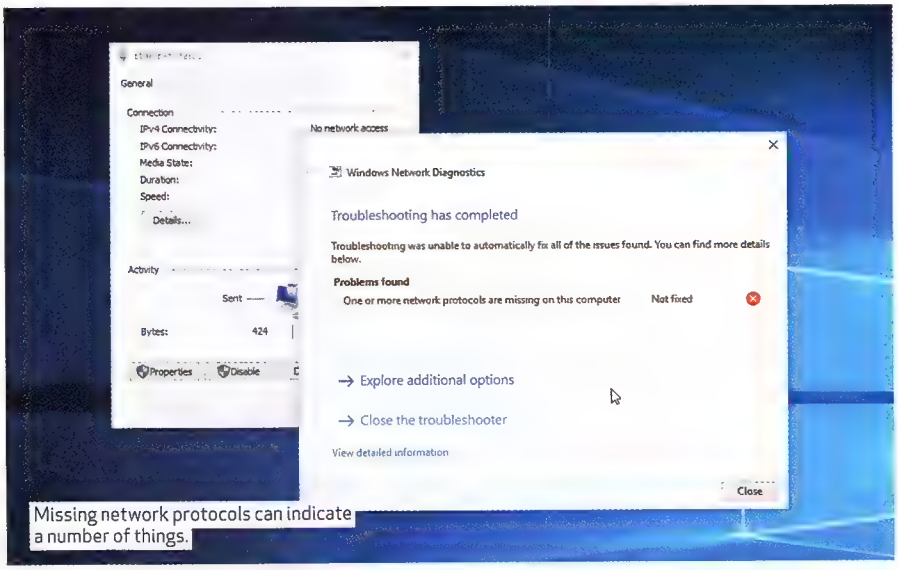
LOSING MY CONNECTION

I recently moved over to Windows 10 via a new ASUS PC, but frequently keep encountering the following error message: 'Hmm we can't read this page', whenever I try to open a web page in Edge. If I reboot, the problem goes away, but only temporarily, and it appears to affect my entire connection, including other web browsers and Edge. Would you be able to help?

Geoff Laughton

Geoff had run the Network Connection Troubleshooter, which gave him the message, 'One or more network protocols are missing on this computer'.

Ironically, during the troubleshooting process, we experienced the same error – in our case, our network connection failed completely after a Windows Update, but in our case, it appears the update had wiped our static IP settings, which we had to put back in manually. This clearly wasn't Geoff's problem – we asked him to check the Reliability Monitor, which showed no related issues, and neither did a HijackThis! log suggest any foul play. He ran an sfc/scannow check, which found no issues, so we pointed him towards the Complete Internet Repair tool at



Missing network protocols can indicate a number of things.

There are many PC hardware repair jobs that you can do yourself. Replacing a cracked, curved display isn't one we'd recommend.

rizonesoft.com/download/complete-internet-repair. Geoff duly ran the portable tool and discovered that ticking 'Renew Internet Connections' and clicking the '>' button fixed the problem – temporarily at least. It saves him having to reboot, and we're continuing to consult with him to find a permanent solution.
Graham Barlow

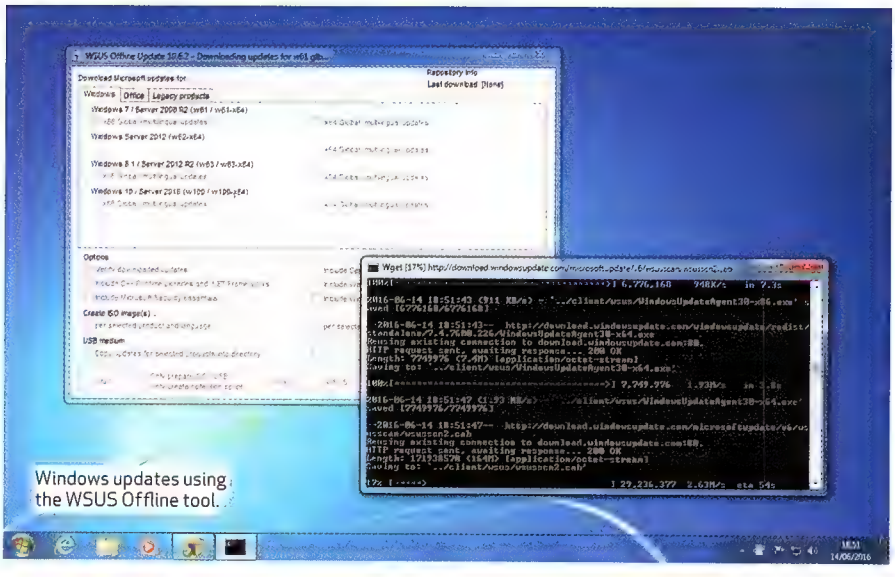
HARDWARE
FIX A CRACKED DISPLAY

I recently purchased an HP Envy 34 All-in-One. When I got the system set up, I quickly figured out how slow a 5,400rpm hard drive really is. It's been a long time since I purchased a pre-built computer, so I didn't have much choice in components. To make a long story short, replacing that disk necessitates going in through the front of the machine. Swapping drives was easy, but in the process I cracked the screen. I've been 'working' with HP for three months now to get it replaced at my cost. They're telling me that it might be doable, though it's basically just a screen replacement. Do you know of anywhere else I can get this done? Everything I find online is either sales-related or an editorial preview of the system. **Drew Hudson**

There are some PC repair services we'd refuse to pay for, but replacing a cracked (curved) LCD screen is not one of them. It appears that the Envy 34 employs a Samsung SVA-based panel (specifically, the LTM340YP01). These are available from a handful of suppliers in Asia. But do you really want to roll the dice on shipping, potential quality issues or even the do-it-yourself install? See what HP asks for the replacement job, and then decide if the swap using OEM parts is worth it.
APC team

WINDOWS
WINDOWS 7 UPDATE ERROR

I recently had a hard drive crash, so had to recover Windows XP from a recovery disc then upgrade to Windows 7. All went well until the last successful update back in February; since then, it seems to have stalled — eventually after several hours, it failed with a '0x80080005' error. A similar problem occurred with another PC too, with Microsoft's Fixit tool unable to resolve the update feature. Can you help?
Graham Francis



Windows updates using the WSUS Offline tool.

We pointed Graham to the WSUS Offline Update tool at **www.wsusoffline.net** – this allows you to download all the updates separately and then apply them offline, which may resolve issues where updates haven't been installed in the correct order. Second, many Windows 7 users have been complaining about slow updates since October 2015 – download the two updates at **support.microsoft.com/kb/3083710** and **support.microsoft.com/kb/3102810** and install them manually to hopefully resolve this issue.

Sadly, in Graham's case, the original hard-disk crash may have been the foreshadowing of worse to come – while following our steps, his computer developed a strange noise and refused completely to boot. We gave him some troubleshooting steps to follow, with the possibility that his hard drive had failed, but haven't heard back since.
Matt Hanson

SOFTWARE
GETTING RID OF DUPLICATE FILES

How can I get rid of multiple copies of photos and music in Windows? I've used Picasa for photos, but before that, I used other managers. I've tried iTunes and Google Music for my music, which is complicated too. I've also migrated data from several PCs and Macs. Is there a reliable solution to get it down to one copy on my PC and one in the cloud?
Cliff Wiebe

So long as the duplicates are all still very similar – in other words, you haven't converted between formats or made major edits – then you've every chance of consolidating your files.

First, you need to work out where all your duplicates reside – if they're inside a single parent folder then things will be easier, but a free tool, such as dupeGuru (**www.hardcoded.net/dupuguru**) will help, even if they're scattered across multiple drives and folders. dupeGuru comes in three flavours, so use the specialised music and picture tools.

Select the folders you wish to scan for duplicates, then wait for dupeGuru to match by various criteria (including content, size and dimensions). Each match is given a rating between 1 and 100, then just click the 'Detail' button before selecting a duplicate to compare it to the original before sending it to the Recycle Bin or moving it elsewhere.

Once done, consolidate your remaining copies within Music and Pictures folders inside your cloud storage folder of choice, then point your music and image-editing tools to these locations going forward.
Matt Hanson

Master Messages in iOS 10

Discover how to have a lot more fun with your casual communications with Alan Stonebridge.

Messages may well be the most changed app in iOS 10 thanks to a raft of new features for conversations using Apple's iMessage service. At last, you can liven up your conversations with all sorts of effects and rich interactions, not just text and emoji.

For starters, you can send messages with special effects so that they slam down on the screen, are obscured with an 'invisible ink' effect that the recipient must swipe over to reveal your message, or are accompanied by a parade of balloons that float up and off the screen. Note, though, that only other people on iOS 10 can see these features at their best – on older versions, and even on macOS Sierra, the recipient will see a textual description of whatever effect you apply to a message, such as '(sent with Confetti)' or '(sent with Loud Effect)'.

Messages now has its own App Store, which provides downloads of apps and sticker packs for you to use in conversations. You can send stickers like photos, or you can affix them to specific positions over a message bubble. Apps enable all sorts of things in Messages. For example, you can run a poll among friends, share to-do lists, or look up and share info from services such as OpenTable, Yelp and IMDB right from within a conversation.

If those features are a bit much for you, perhaps you could indulge in fun with emoji. After typing a message, tap the emoji key and words that can be replaced with emoji are highlighted; tap those words you want to replace – each is optional.

CROSS-PLATFORM COMPLEXITIES

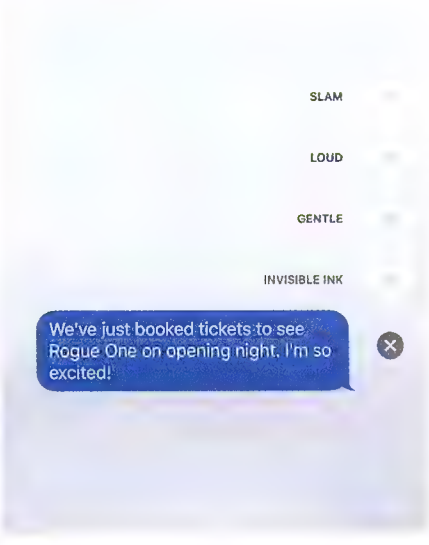
Bear in mind that many features only work in iMessage conversations. However, stickers work in regular ones, too, where they're sent using MMS. That can quickly rack up a bill with your mobile network, but you can take steps to prevent that happening.

iMessages have blue bubbles and regular SMS and MMS ones have green ones, so you can work out whether sending a sticker will cost you money or come from your data allowance. This isn't foolproof, as Messages falls back on SMS and MMS if it can't reach Apple's service. The safest solution all round is to go to 'Settings > Messages' and turn off MMS Messaging. You might instead simply choose to enable Low-Quality Image Mode in that location to save a little bandwidth.

In the same place, check that you're signed in to iMessage. With that done, let's try out the mix of fun and practical new features in the latest version of Messages.

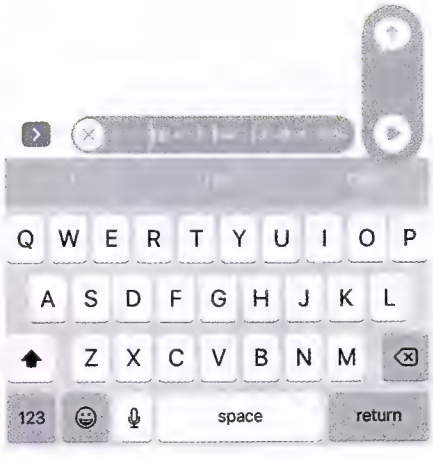
How to:

Have great conversations in Messages



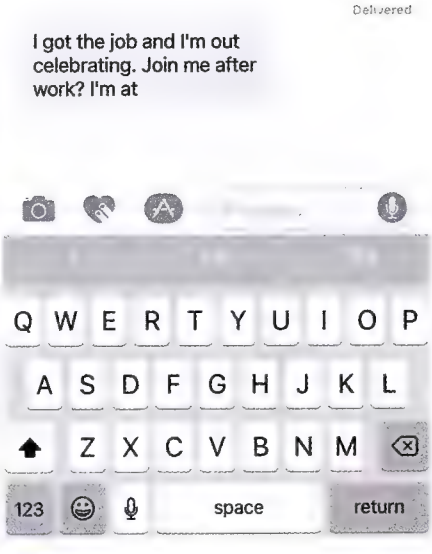
1 SEND WITH VISUAL EFFECTS

Compose a message, then hold a finger on (or apply 3D Touch to) the send button to reveal a list of effects; tap next to one's name to preview it, and again to send that effect, or tap Screen and swipe left/right to pick a full-screen animation.



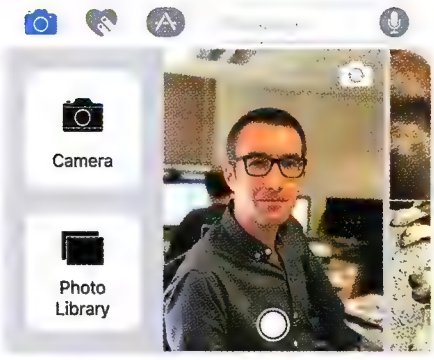
2 SEND AN AUDIO MESSAGE

Hold a finger on the microphone icon at the right of the message box to start recording an audio message. Slide your fingertip up to the send button and let go to send immediately, or lift your finger and then tap play to review it first.



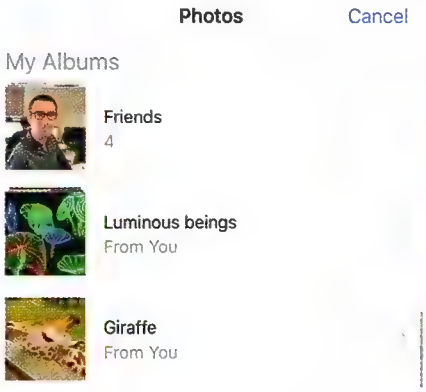
3 SEND A PHOTO

With the focus in the message box, the icons normally to the left are hidden; tap the arrow there, then tap the camera icon. On the live view, tap the top-right icon to switch cameras, or anywhere else to take and add a photo to your message.



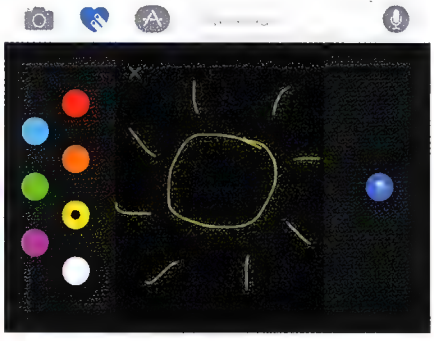
4 FULL CAMERA CONTROLS

If you want to use other camera modes, swipe right on the live preview and then tap Camera. If you took the photo you want to use before opening Messages, swipe left instead to browse your recently taken pictures.



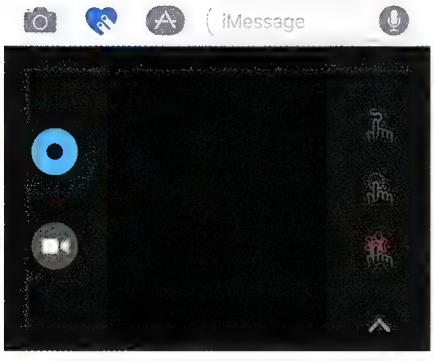
5 SEND OLDER MEDIA

To send an older photo, swipe right on the live preview and tap Photo Library. Browse your albums and choose the photo to send. Once it's attached to your message, tap it to edit the colours or add annotations to the copy that'll be sent.



6 DIGITAL TOUCH SKETCHES

Tap the icon of two fingers over a heart. Tap the white circle with a black centre to pick a colour, then slide your finger on the large black square to draw. When you send the sketch, the recipient sees it build up just like you drew it.



7 DIGITAL TOUCH EFFECTS

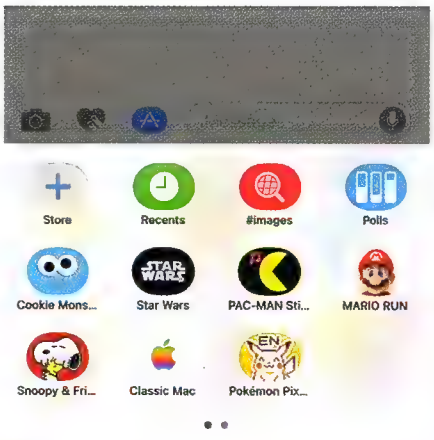
Tap the three icons to the right of the sketchpad to see interactions you can use to add a range of effects. If you want more room for sketching, tap the upwards-pointing arrow to expand the sketchpad so it almost fills the screen.

8 SKETCH OVER MEDIA

Tap the heart icon, then the camera, pick a camera to use, then tap the white concentric circles to take a photo, or the red and white ones for video, then sketch. The recipient sees your drawing build over video with your original timing.

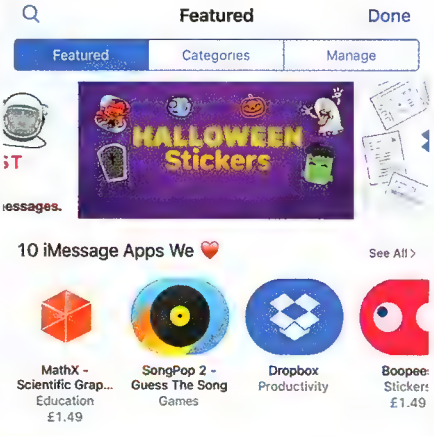
9 APPS AND STICKER PACKS

Tap the third icon to the left of the message box, which looks like an 'A', and the lower part of the screen will change; swipe left or right on it to browse your installed apps and stickers; the leftmost page shows your recently used stickers.



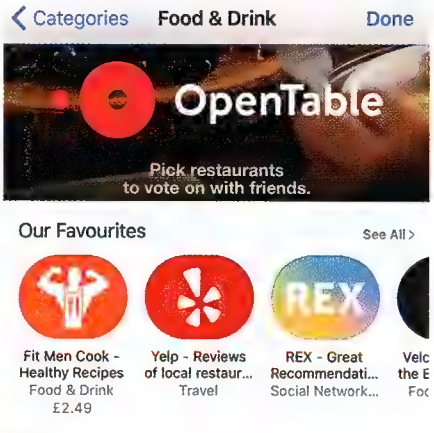
10 MORE DIRECT ACCESS

As you add apps and sticker packs, swiping to find the one you want feels slow. To jump directly to one, tap the icon of four ellipses (bottom left) to open the app drawer, which shows their icons in a grid. Tap the one you want.



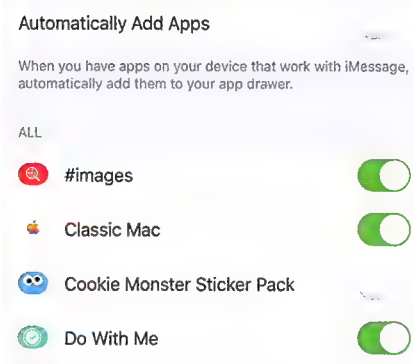
11 GET IMESSAGE STICKERS

You may already have a bunch of iMessage apps and stickers that came with regular apps you've installed. To see others that are available, tap the '+' bubble in the app drawer, labelled Store, to open the App Store for iMessage.



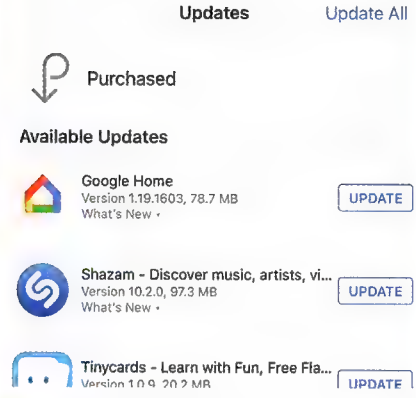
12 GET IMESSAGE STICKERS

Use the first two tabs (Featured and Categories) or the magnifying glass icon at the top left to explore or search what's available. Purchase or get free iMessage apps and sticker packs as you would apps in the regular App Store.


Automatically Add Apps
When you have apps on your device that work with iMessage, automatically add them to your app drawer.
ALL
#images
Classic Mac
Cookie Monster Sticker Pack
Do With Me

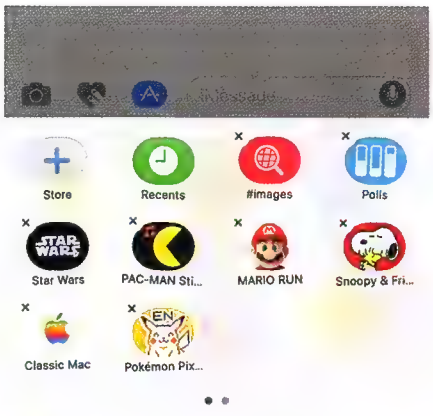
13 MANAGE THE DRAWER

The Manage tab lists your installed apps that plug in to Messages or provide a sticker pack for it. The switch at the top automatically adds newly installed items to the drawer. Use the switches below to turn off apps (but keep them installed).



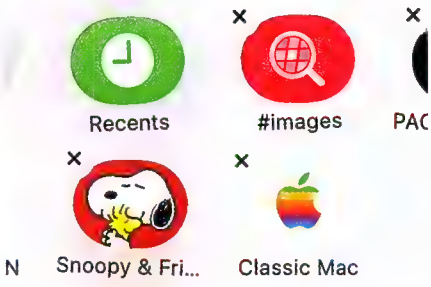
14 ARRANGE DRAWER ITEMS

Tap Done at the top of the three-tab panel to return to your conversation, with the app drawer still open. To change the arrangement of the drawer's icons, hold a finger on one until they all jiggle, then drag them into your desired order.



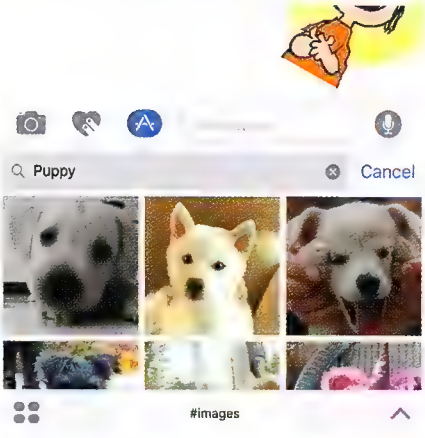
15 REMOVE DRAWER ITEMS

Tap the cross on a jiggling icon to remove that app or sticker pack; if solely used with iMessage, this uninstalls it. Otherwise, it can be restored as in step 13, or you can get rid of it altogether by removing its icon from the Home screen.



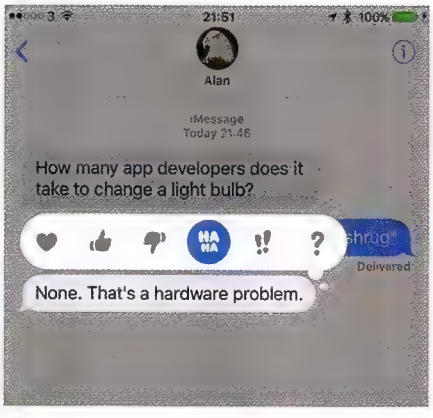
16 REINSTALL ITEMS

Press the Home button to finish rearranging the app drawer. Removed apps and sticker packs can be reinstalled by finding them in the App Store within Messages or by using the search bar in the App Store app's Purchased section.



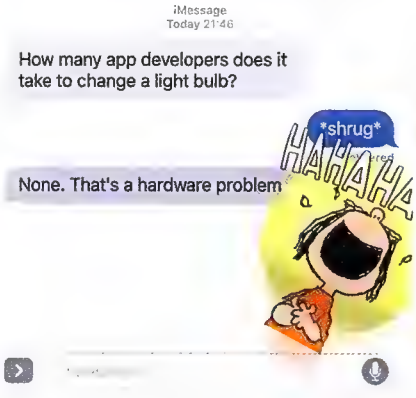
17 SUPER-QUICK RESPONSES

Double-tap a received message, then tap a Tapback response in the bubble that appears: a heart, thumbs up or down, laugh out loud, exclamation marks or a question mark; it appears to other participants on the same bubble.



18 APPLY A STICKER

Navigate to a sticker pack in the app drawer. Tap a sticker to send it like a regular image, or hold a finger on it to peel it off, then drag and drop it on or close to a message bubble; you can pinch or turn two fingers to resize or rotate it

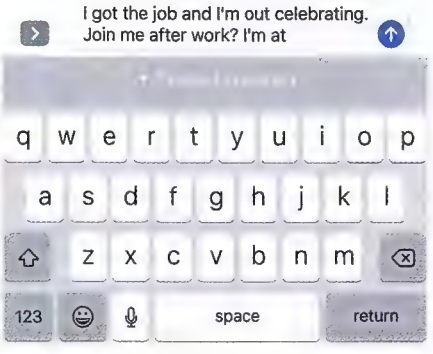


19 USE AN IMESSAGE APP

Apps in iMessage work in a variety of ways, depending on their function. The #images one provided with iOS has a search bar for finding pictures online, under which it sometimes suggests keywords based on your conversation.

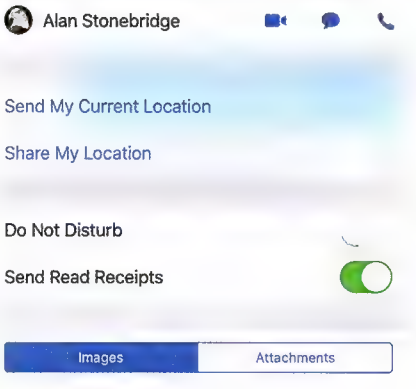
20 QUICKTYPE SHORTCUTS

Type "I'm at" or receive "Where are you?" and you can quickly send your location from above the keyboard. Things like "John's birthday is" and "My address is" also work, but success varies; "When is John's birthday?" didn't work for us.



21 SELECTIVE READ RECEIPTS

In 'Settings > Messages' is a switch that controls whether read receipts are sent for all iMessage chats. To override its status for an individual conversation, tap Details at the top right and toggle the Send Read Receipts switch here. ■



Make and manage disk sets in macOS

Alan Stonebridge shows how to combine disks for faster transfers or to provide extra protection for files.

Disk Utility in Sierra adds the ability to create and manage disk sets. Strictly speaking, you could also manage disk sets in El Capitan, but you had to do so in Terminal, using the diskutil command. So, an immediate benefit of Sierra is that it's more comfortable to work with disk sets, whether a prebuilt one that depends on this macOS feature or a set you assemble from separate drives.

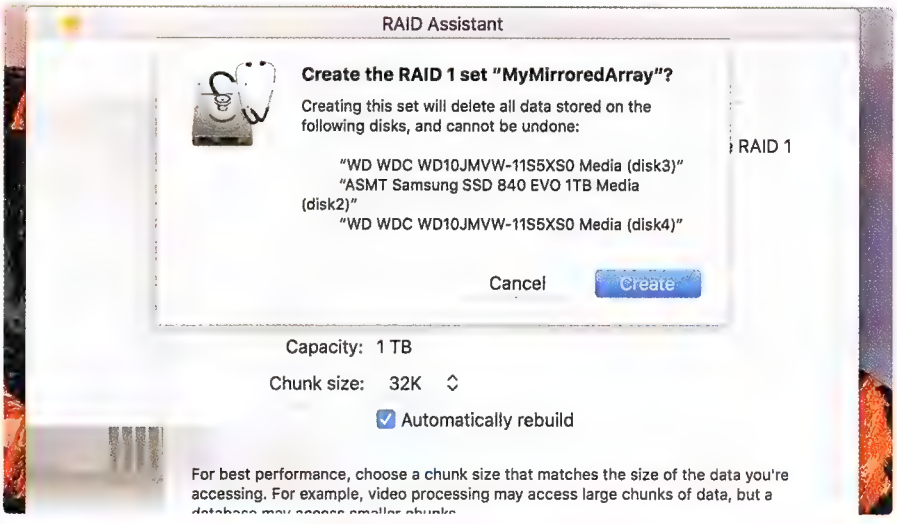
A disk set takes multiple disks – a minimum of two – and pools their resources in one of three ways. The first is a striped disk set, or RAID (Redundant Array of Independent Disks) level 0. This type of set has the cumulative capacity of all its disks. It may spread chunks of data, even of part of the same file, across its disks to distribute the burden of read and write operations, improving the set's overall throughput. However, the risk here is that, if one disk fails, the whole set's data is lost.

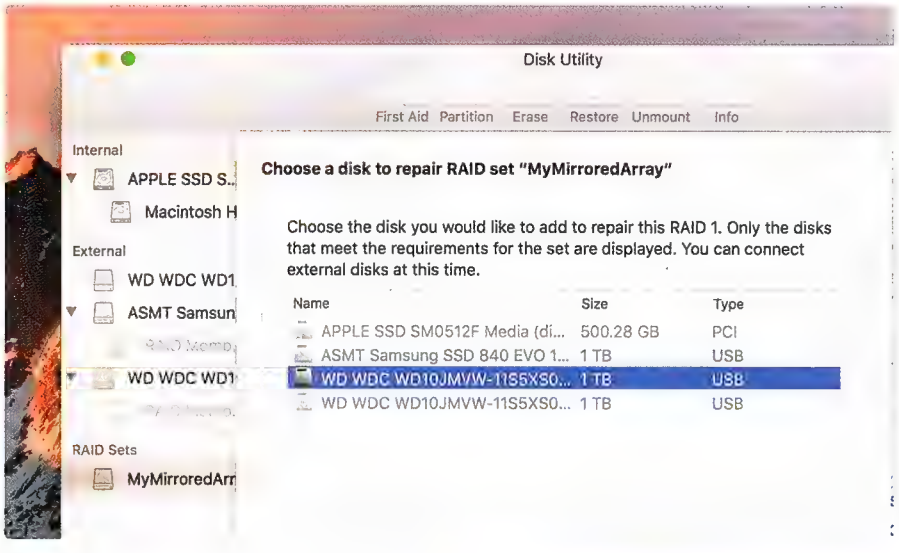
The second is a mirrored disk set, also known as RAID level 1, and for many people, it's the most compelling of the three options available in Disk Utility due to the additional protection it affords to your files; whatever you copy to a mirrored set is stored multiple times – once on each of the disks in the set. The advantage of this is that, as long as one disk does not fail, you can rebuild the array by replacing those that have become faulty.

The worst cases here are if data on every disk becomes corrupted or all of the disks fail at the same time. The former situation can be addressed by creating one or more periodic backups of the mirrored set and storing that separately, in the hope of limiting propagation of any damage. The latter situation can be dealt with by adding one or more extra disks to the set, either as additional slices (live copies of all the data stored by the set) or as spares, which are ordinarily idle and only called into action when a slice fails, in order to rebuild the set so that you have your desired minimum number of copies.

A mirrored disk set's capacity is the same as the lowest capacity disk that's part of it, so you'll want them to match in order to make the most efficient use of all of them.

The third kind of disk set is JBOD, meaning just a bunch of disks. This simply concatenates the capacity of multiple disks – which can be different – into a single volume. This kind of disk enables several small disks to work like they are one, which you can then use as part of a striped or mirrored array in which other disks match the capacity of the concatenated set. However, this means there are more potential points of failure in the resulting set.


RAID Assistant
Create the RAID 1 set "MyMirroredArray"?
Creating this set will delete all data stored on the following disks, and cannot be undone:
"WD WDC WD10JMVW-11S5XS0 Media (disk3)"
"ASMT Samsung SSD 840 EVO 1TB Media (disk2)"
"WD WDC WD10JMVW-11S5XS0 Media (disk4)"
RAID 1
Cancel
Create
Capacity: 1 TB
Chunk size: 32K
Automatically rebuild
For best performance, choose a chunk size that matches the size of the data you're accessing. For example, video processing may access large chunks of data, but a


Disk Utility
First Aid Partition Erase Restore Unmount Info
Internal
APPLE SSD S...
Macintosh H
External
WD WDC WD1
ASMT Samsun
WD WDC WD1
RAID Sets
MyMirroredArr
Choose a disk to repair RAID set "MyMirroredArray"
Choose the disk you would like to add to repair this RAID 1. Only the disks that meet the requirements for the set are displayed. You can connect external disks at this time.
Name
Size
Type
APPLE SSD SM0512F Media (di... 500.28 GB PCI
ASMT Samsung SSD 840 EVO 1... 1 TB USB
WD WDC WD10JMVW-11S5XS0... 1 TB USB
WD WDC WD10JMVW-11S5XS0... 1 TB USB

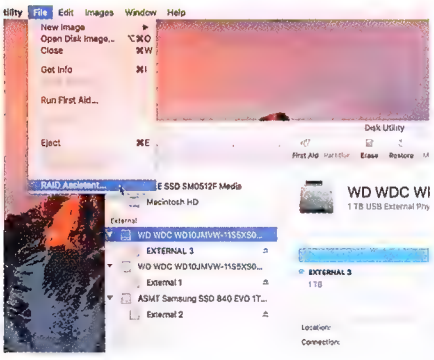
PERFORMANCE CONSIDERATIONS

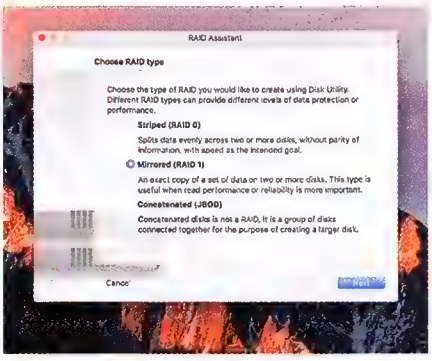
With a striped disk set in particular, try to connect the disks to different ports on your Mac, rather than through a USB hub, which can detrimentally affect the performance of speedy storage devices, notably SSDs.

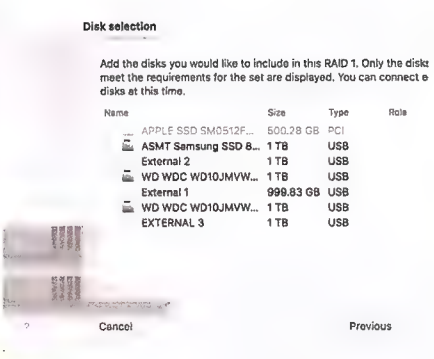
In the walkthrough opposite, you'll learn how to safely set up RAID 0 and RAID 1 disk sets. Before you begin, gather at least two drives that are blank or whose contents you don't need; they will be erased, so make sure you have a backup of anything on them that you want to keep

How to

Create a disk set in Sierra

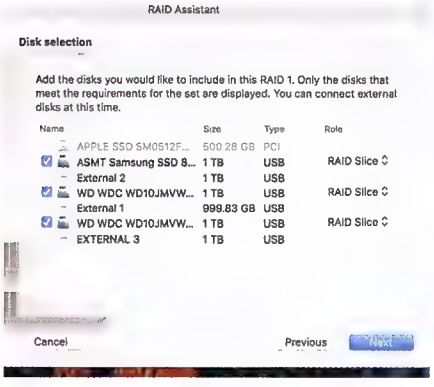



RAID Assistant
Choose RAID type
Choose the type of RAID you would like to create using Disk Utility. Different RAID types can provide different levels of data protection or performance.
Striped (RAID 0)
Splits data evenly across two or more disks, without parity of information, with speed as the intended goal.
Mirrored (RAID 1)
An exact copy of a set of data on two or more disks. This type is useful when read performance or reliability is more important.
Concatenated (JBOD)
Concatenated disks is not a RAID. It is a group of disks connected together for the purpose of creating a larger disk.
Cancel
Next


Disk selection
Add the disks you would like to include in this RAID 1. Only the disks
meet the requirements for the set are displayed. You can connect e
disks at this time.
Name Size Type Role
APPLE SSD SM0512F... 500.28 GB PCI
ASMT Samsung SSD 8... 1 TB USB
External 2 1 TB USB
WD WDC WD10JMVW... 1 TB USB
External 1 999.83 GB USB
WD WDC WD10JMVW... 1 TB USB
EXTERNAL 3 1 TB USB
Cancel
Previous

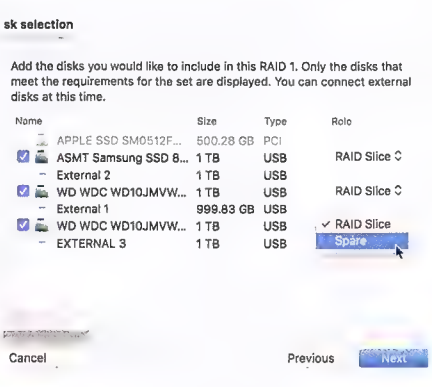
1 CREATE A DISK SET

Connect to your Mac all of the disks you want to be part of the disk set. For safety, disconnect other disks that won't be part of the set to ensure you don't accidentally erase their contents in this process. Choose 'File > RAID Assistant'.


RAID Assistant
Disk selection
Add the disks you would like to include in this RAID 1. Only the disks that meet the requirements for the set are displayed. You can connect external disks at this time.
Name Size Type Role
APPLE SSD SM0512F... 500.28 GB PCI
ASMT Samsung SSD 8... 1 TB USB RAID Slice
External 2 1 TB USB
WD WDC WD10JMVW... 1 TB USB RAID Slice
External 1 999.83 GB USB
WD WDC WD10JMVW... 1 TB USB RAID Slice
EXTERNAL 3 1 TB USB
Cancel
Previous
Next

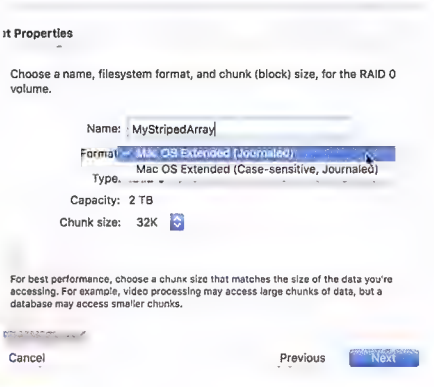
2 CHOOSE A SET TYPE

You'll be shown three descriptions, corresponding to those on the facing page, of the three types of disk set you can create and manage using Disk Utility. Select the type you want to create, then click the Next button.


sk selection
Add the disks you would like to include in this RAID 1. Only the disks that meet the requirements for the set are displayed. You can connect external disks at this time.
Name Size Type Role
APPLE SSD SM0512F... 500.28 GB PCI
ASMT Samsung SSD 8... 1 TB USB RAID Slice
External 2 1 TB USB
WD WDC WD10JMVW... 1 TB USB RAID Slice
External 1 999.83 GB USB
WD WDC WD10JMVW... 1 TB USB RAID Slice
EXTERNAL 3 1 TB USB Spare
Cancel
Previous
Next

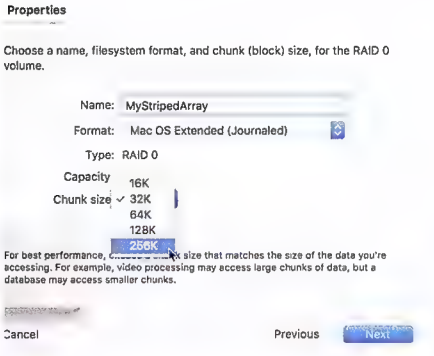
3 REVIEW AVAILABLE DISKS

You'll be presented with a list of all the disks connected to your Mac, and the volumes on them. Your startup disk will be dimmed as it can't be used. To aid in their identification, each one's connection type and capacity are also listed.


t Properties
Choose a name, filesystem format, and chunk (block) size, for the RAID 0 volume.
Name: MyStripedArray
Format: Mac OS Extended (Journaled)
Mac OS Extended (Case-sensitive, Journaled)
Type:
Capacity: 2 TB
Chunk size: 32K
For best performance, choose a chunk size that matches the size of the data you're accessing. For example, video processing may access large chunks of data, but a database may access smaller chunks.
Cancel
Previous
Next

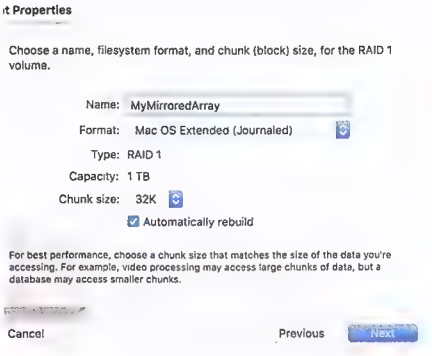
4 CHOOSE DISKS FOR THE SET

Disks and volumes are organised much like they are in the left pane of Disk Utility's main window, with volumes indented slightly under the disk they are on. Click the checkboxes next to each disk you want to include in the set.


Properties
Choose a name, filesystem format, and chunk (block) size, for the RAID 0 volume.
Name: MyStripedArray
Format: Mac OS Extended (Journaled)
Type: RAID 0
Capacity
Chunk size
16K
32K
64K
128K
256K
For best performance, choose a chunk size that matches the size of the data you're accessing. For example, video processing may access large chunks of data, but a database may access smaller chunks.
Cancel
Previous
Next

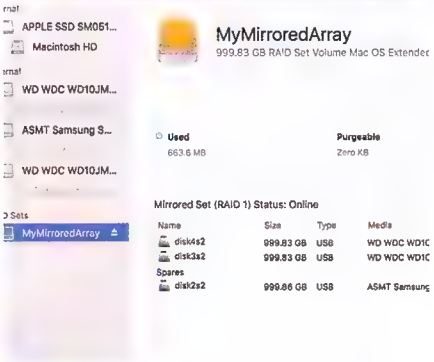
5 SET EACH DISK'S ROLE

Each disk in a mirrored set must be designated as a RAID slice, to contain your data (two minimum) or a spare. Spares are optional but offer some extra protection; they are used to rebuild a set if a slice becomes inaccessible. Click Next.


t Properties
Choose a name, filesystem format, and chunk (block) size, for the RAID 1 volume.
Name: MyMirroredArray
Format: Mac OS Extended (Journaled)
Type: RAID 1
Capacity: 1 TB
Chunk size: 32K
Automatically rebuild
For best performance, choose a chunk size that matches the size of the data you're accessing. For example, video processing may access large chunks of data, but a database may access smaller chunks.
Cancel
Previous
Next

6 SET DISK SET PROPERTIES

You need assign a name to your disk set, which is what will be shown in Finder. Of the two choices offered for the set's format, the most common one to choose is Mac OS Extended (Journaled) — that is, the one that isn't case-sensitive.



7 CHUNK SIZE (STRIPED SETS)

With a striped set, chunks of data that make up each file are spread across the disks. If you chose this type for faster transfers, a smaller chunk size is more efficient; one disk can read a small chunk while another looks for the next one.

8 CHUNK SIZE (MIRRORED)

In a mirrored set, pick a large chunk size if it'll store videos or other big files, or a smaller one for simpler files. With 'Automatically rebuild' on, if a disk fails or is removed, the set is rebuilt using a spare; a reconnected disk then becomes a spare.

9 FINISH CREATING THE SET

Click Create, then Done. In Finder, the set acts like a regular disk. To check its status, such as during rebuilding of a mirrored set, select it under RAID Sets in Disk Utility's left pane. You can later add more slices or spares to a mirrored set.

Encrypt drives in Linux

Undercover operative Mayank Sharma reveals the secrets of VeraCrypt to help you hide your data from unscrupulous invaders of privacy... or your mum.

A simple user password is not enough protection for your critical data and personal files. To truly protect your files from being routinely accessed, manipulated or disappeared as some miscreants are wont to do, you must encrypt your data.

If done right, encrypted data appears unintelligible to people without the means to decrypt it. The most basic option to protect yourself is to individually encrypt each of your sensitive files. But this is a time-consuming and tedious process and requires routine decryption of such files which is a further waste of time. The smarter way is to create an encrypted disk or partition, which would automatically encrypt everything stored within.

This is where VeraCrypt shines. It enables you to carve a virtual slice out of your Linux storage space which acts as a standalone encrypted filesystem. You then mount it, use it to store and read files as you would from a normal partition, then unmount it when you're done without leaving any clues behind.

HIDEY HOLES

VeraCrypt, which is based on version 7.1a of the now-defunct TrueCrypt, has inherited its parent's vast functionality and also some quirks like its licence, which is why it isn't available in any distribution's (distro) software repository (repos). In a stark departure from other popular Linux tools, the project also doesn't supply its own packages for popular distros, but installing it is a trivial affair nonetheless. You simply grab the tarball available on the website and uncompress it to access the console and graphical installation scripts for 32- and 64-bit machines. As Ubuntu already ships with the FUSE library, you only need to install VeraCrypt's other dependency, device mapper tools. You can do just that with the following command: `sudo apt-get install dmsetup`

VeraCrypt supports on-the-fly encryption, which means it encrypts data before saving it and automatically decrypts it upon loading, without any user intervention. It makes full use of your modern hardware at its disposal, minimising the lag due to the overhead of converting unintelligible bit stream into meaningful data that can be read by your text editor or played by your media player.

The first step towards hiding your data is to create an encrypted volume to store files on. Launch the app, and click on the 'Create Volume' button. This launches the Volume Creation Wizard which enables you to either create a virtual encrypted disk within a file or an encrypted volume within an entire partition, even a disk such as a removable USB drive.

CREATING AN ENCRYPTED VOLUME

When you select the first option to create a virtual disk, VeraCrypt asks you to point it to a file on the disk which will serve as the encrypted volume. If the file exists, VeraCrypt will recreate it, using one of the eight encryption algos. Next, specify the size of the encrypted volume, and the filesystem format. The final step is to choose a password to mount the encrypted volume.

To store files on the volume, you'll have to mount it, so select the encrypted volume file from the VeraCrypt main interface, press the 'Mount' button and enter the password when prompted. You can access additional settings such as the option to mount a volume as read-only, if all you wish to do is read files from it, by clicking 'Option' at the bottom-right of the password dialog box.

By default, VeraCrypt doesn't remember the name of the file you're using as an encrypted volume. This is a security feature and adds another roadblock in the path of an intruder. If you ask the application to remember the name of the file, anyone with physical access to your machine can select the file from a pull-down menu and mount the encrypted volume. However, they will still have to get past your password. When mounted, you can save files to an encrypted volume just like you would to a regular volume.

You must always dismount volumes as soon as you're done. When it isn't mounted, the encrypted filesystem appears to be a random jumble of bits. You can think of it as a file that's got its 1s and 0s mixed up and hence can't be read by any application.

Volume header

The standard volume header uses the first 512 bytes of the VeraCrypt container. It contains the master keys needed to decrypt the volume. If the header gets corrupted, VeraCrypt will no longer be able to mount a volume. To prevent such an occurrence, each volume created by VeraCrypt also contains an embedded backup header, located at the end of the volume.

But just to be doubly sure that no travesty befalls the guardian of all your secrets, you can create an external backup for the headers. From the main VeraCrypt window, select the volume file and then click 'Tools > Backup Volume Header' and follow the instructions on the wizard.

If your volume also contains a hidden volume, the wizard will ask you for its password so that its header info is also stored in the backup. The external backup header so created does not contain any unencrypted information, except for salt, which is a collection of random numbers.

When restoring a volume header, click 'Tools > Restore Volume Header' and the wizard will lead you through the appropriate steps. During the restoration, you must enter the volume password/keyfile that was valid when the backup was first created.

This also implies that, if you've changed the volume's password since the last external backup, restoration from the backup will revert the volume to the original password.

Added security using keyfiles

In addition to using passwords to protect your encrypted volumes, VeraCrypt also offers the option of combining passwords with keyfiles, which will significantly bolster security.

Just about any file on your machine can be used as a keyfile. VeraCrypt will not mount a volume, even on providing the correct password, if the user also doesn't specify the keyfile. The content of a keyfile isn't modifed so there's no risk of damaging the data it contains.

While you can use any file as a keyfile, only compressed files such as MP3, TAR and JPG are recommended. In case of MP3 files, make sure that tags such as artist name, title and so on aren't modified, once the file has been used as keyfile.

You can specify multiple files as keyfiles and even generate keyfiles using VeraCrypt. When you arrive at the password dialog in the Create Volume wizard, select the 'Use keyfiles' option and then click the 'Keyfiles' button. Click the 'Add Files' button if you wish to use an existing file on your machine as the keyfile or click the 'Generate Random Keyfile' button on the bottom-right.

If you wish to use keyfiles for all volumes by default, click 'Settings > Default Keyfiles' on the main VeraCrypt window. Now specify the file(s) you wish to use by clicking 'Add Files' at the bottom of the Preferences dialog box. Finally, click the 'Use keyfiles by default' checkbox.

HIDDEN VOLUMES

Another and perhaps far more useful feature is VeraCrypt's ability to create a hidden volume. You can think of these as an encrypted volume within an encrypted volume. When creating a volume, the wizard asks you the type of volume you wish to create, and gives you the option to either create a standard volume or a hidden volume. For most situations where you just need to shield documents from prying eyes, you can opt for the first option, which we've already discussed.

A hidden volume gives you the added advantage of plausible deniability. In security parlance, this means that even after being forced to give out the password for a (decoy) encrypted volume, you can convincingly deny the existence of other encrypted volumes. Creating a hidden volume gives you this kind of safeguard. To create a hidden volume, select the 'Hidden VeraCrypt Volume' option when you create a new volume. The application will first create an outer volume and let you add non-sensitive data to it. It then calculates the maximum possible size you can allocate to the hidden volume. Although it should go without saying, ensure that the password for the inner hidden volume is different from that of the outer encrypted volume.

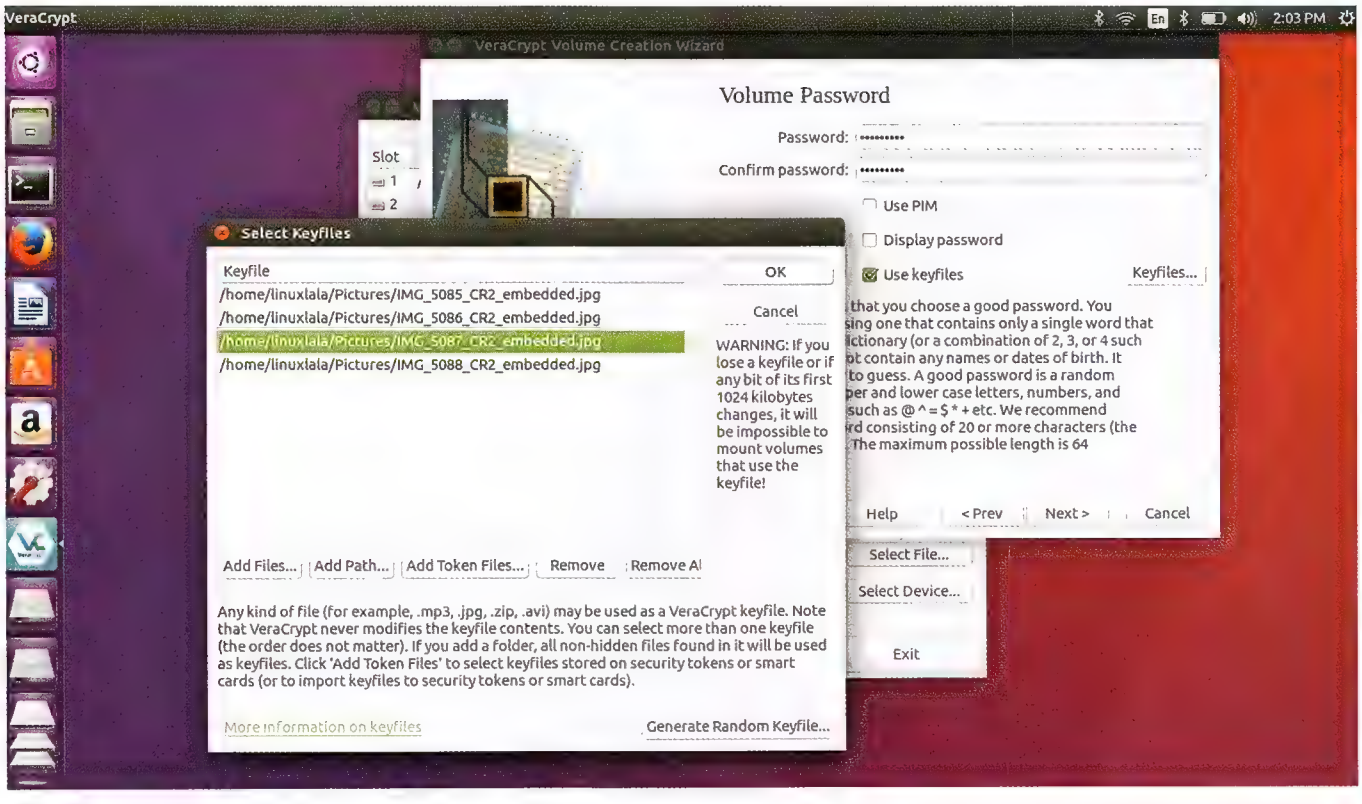
MOUNTING VOLUMES

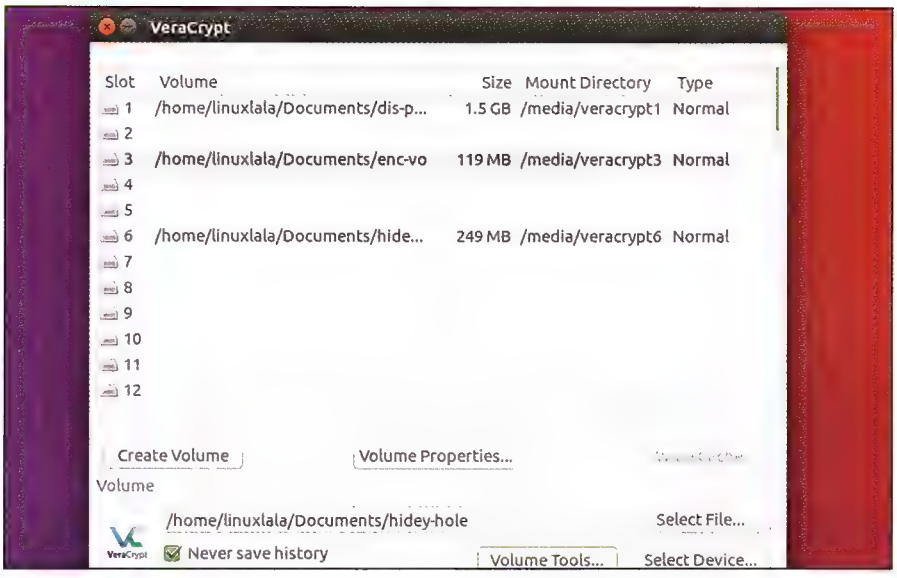
You mount a hidden volume in almost the same way as a standard VeraCrypt volume. The only difference is that when you select the file, partition or device that is the outer volume, VeraCrypt mounts the hidden volume only if you specify its password. In other words, if you enter the password for the outer volume, that will be mounted, and if you enter the password for the inner volume, the hidden volume will be mounted.

Although not a drawback, one crucial aspect when working with hidden volumes is that, although you can read from the outer volume, writing to it might end up corrupting the hidden volume. If you wish to be able to write to the outer volume without risking any damage to the inner volume, you must check a special option when you enter the password for mounting the outer volume. Expand the 'Option' section and select 'Protect hidden volume when mounting outer volume'.

ENCRYPTION ON STEROIDS

Encryption software makes use of ciphers to encrypt your data. A cipher

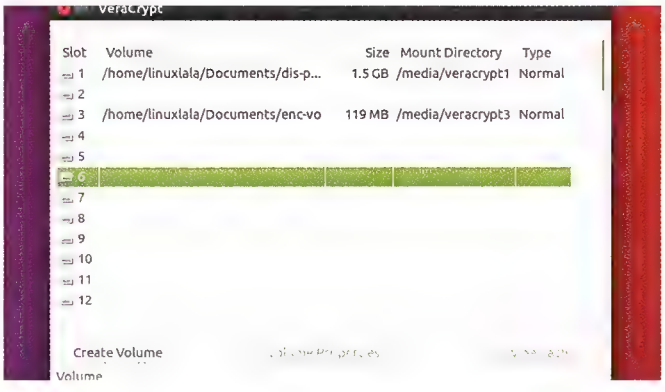

VeraCrypt
2:03 PM
VeraCrypt Volume Creation Wizard
Volume Password
Password:
Confirm password:
Use PIM
Display password
Use keyfiles
Keyfiles...
Slot
1
2
Select Keyfiles
Keyfile
OK
Cancel
/home/linuxlala/Pictures/IMG_5085_CR2_embedded.jpg
/home/linuxlala/Pictures/IMG_5086_CR2_embedded.jpg
/home/linuxlala/Pictures/IMG_5087_CR2_embedded.jpg
/home/linuxlala/Pictures/IMG_5088_CR2_embedded.jpg
WARNING: If you lose a keyfile or if any bit of its first 1024 kilobytes changes, it will be impossible to mount volumes that use the keyfile!
Add Files...
Add Path...
Add Token Files...
Remove
Remove Al
Any kind of file (for example, .mp3, .jpg, .zip, .avi) may be used as a VeraCrypt keyfile. Note that VeraCrypt never modifies the keyfile contents. You can select more than one keyfile (the order does not matter). If you add a folder, all non-hidden files found in it will be used as keyfiles. Click 'Add Token Files' to select keyfiles stored on security tokens or smart cards (or to import keyfiles to security tokens or smart cards).
More information on keyfiles
Generate Random Keyfile...
that you choose a good password. You
sing one that contains only a single word that
ictionary (or a combination of 2, 3, or 4 such
ot contain any names or dates of birth. It
to guess. A good password is a random
per and lower case letters, numbers, and
such as @ ^ = $ * + etc. We recommend
rd consisting of 20 or more characters (the
The maximum possible length is 64
Help
< Prev
Next >
Cancel
Select File...
Select Device...
Exit

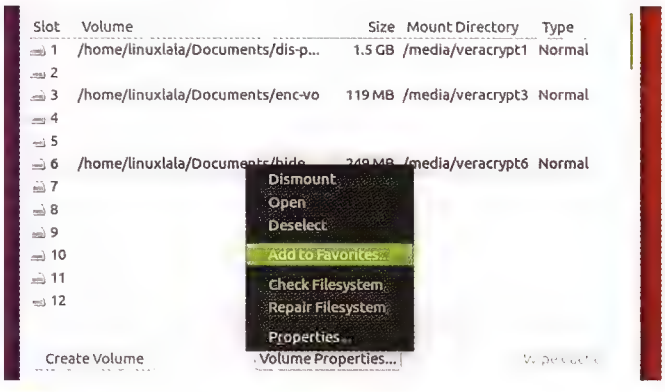


is an algorithm that does the encryption and decryption work for you. This is why the key size of the cipher being used to encrypt data is important. As the key size increases, so does the complexity of exhaustive search to the point where it becomes impractical to crack the encryption directly. The most popular encryption cipher is the Advanced Encryption Standard (AES) which is based on the Rijndael cipher. You'll find that AES with a key size of 256-bits is widely used as it offers the right balance of speed and security.

VeraCrypt also supports cascade encryption, which is the process of encrypting an already encrypted message, either using the same or a different algorithm. VeraCrypt supports five algorithms for this

How to Favourite volumes



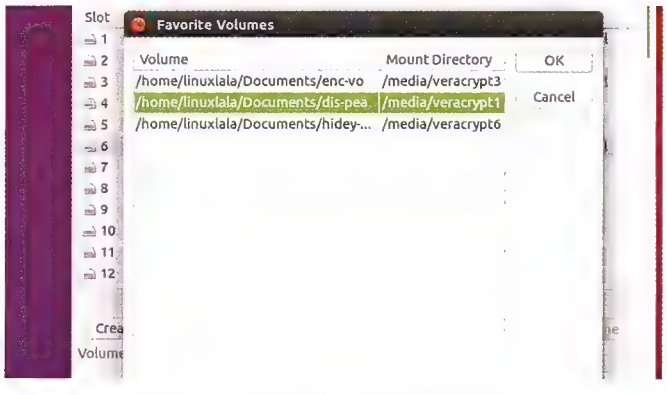


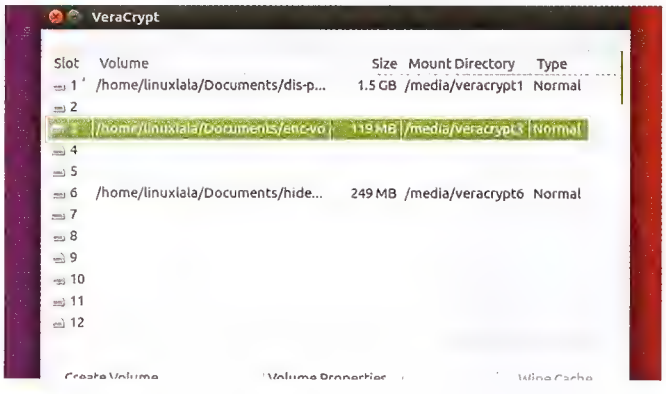
1 SELECT FILE

Favourite volumes are useful when you work with several volumes and need to mount them to their assigned slot every time. For Windows users, another advantage is that your favourite volumes can be auto-mounted as soon as you log in to your machine. Choose a slot in the main window of VeraCrypt, select the volume file and then click the 'Mount' button.

2 SPECIFY FAVORITES

Once the volume has been mounted, select it from the list of mounted volumes and click 'Favorites > Add Selected Volumes to Favorites'. This opens the Favorite Volumes dialog box which lists all your favourited volumes, be they regular or hidden volumes. The volumes are listed in the order they'll be mounted should you choose to mount all your favourite volumes at the same time.





3 ORGANISE FAVOURITE VOLUMES

You can mount all your favourite volumes by clicking 'Favorite > Mount Favorite Volumes'. If you change the password to a volume after having favourited it, you must remove the volume from the list of favourites and then favourite it again. To delete a volume from your list, Click 'Favorites > Organize Favorite Volumes', select the volume from the list and then click 'Remove'.

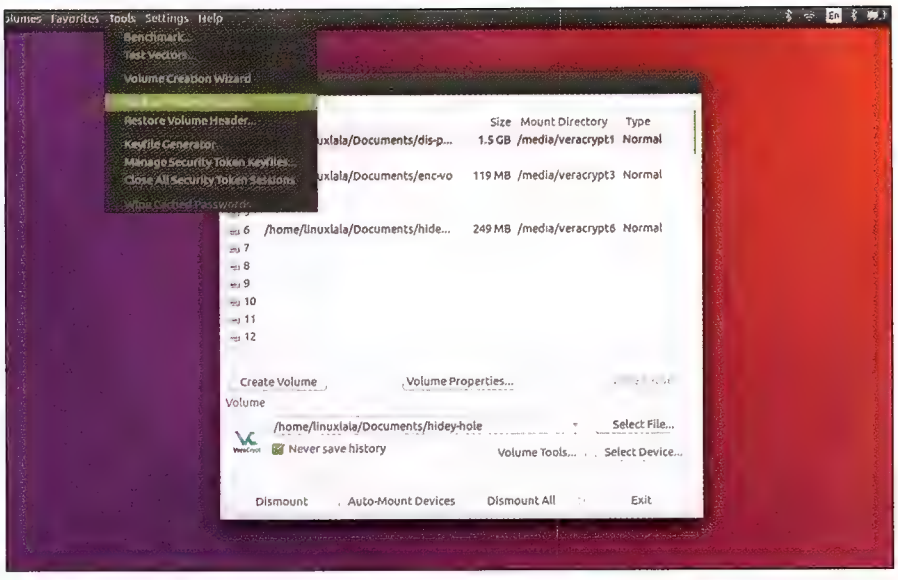
4 DISMOUNT VOLUME

You must make a habit to always dismount a volume as soon as you're done working with it. It would be an absolutely wasted effort if you were to step away from your machine leaving your precious volumes mounted, for anyone can access the files. Click 'Volume > Dismount All Mounted Volumes' to unmount all volumes or select the mounted volume from the list and click 'Dismount'.

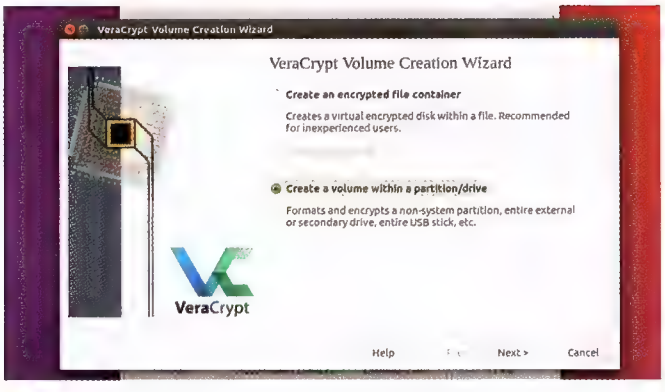
purpose, including AES-Twofish and Serpent-Twofish-AES but you must refer to the project's documentation for details on these algorithms.

What's more, VeraCrypt offers the option of adding salt data to the encrypted container. The salt comprises values generated by VeraCrypt's random number generator, and makes it difficult to pre-compute all the possible keys for a brute force attack. For instance, if a 512-bit salt is used, there are 2,512 keys for each password.

VeraCrypt supplies a lot of powerful features and makes good use of a graphical interface and wizards. It makes an ideal choice for any individual or organisation that values privacy, so give it a go.

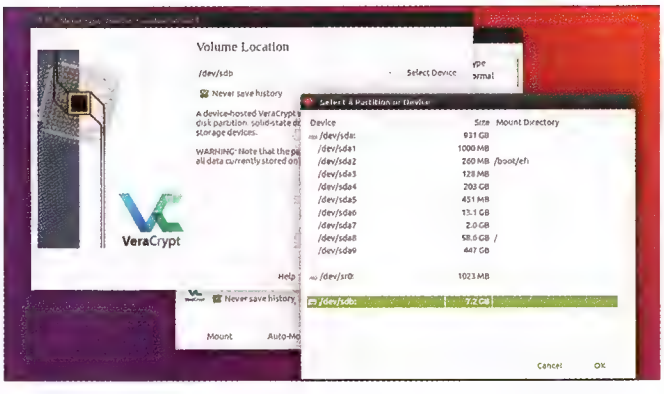


Create an encrypted USB device


VeraCrypt Volume Creation Wizard
VeraCrypt Volume Creation Wizard
Create an encrypted file container
Creates a virtual encrypted disk within a file. Recommended for inexperienced users.
Create a volume within a partition/drive
Formats and encrypts a non-system partition, entire external or secondary drive, entire USB stick, etc.
VeraCrypt
Help
Next >
Cancel

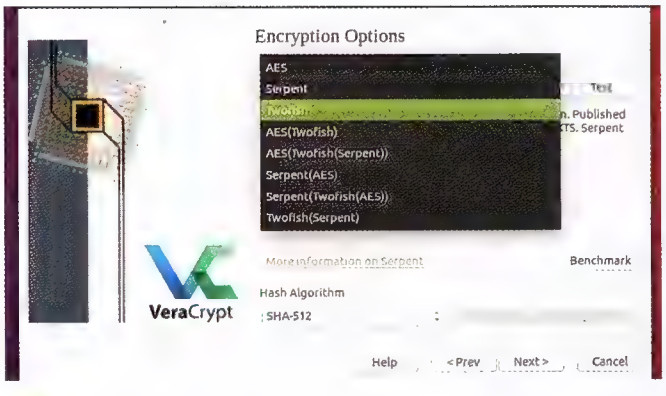
1 CREATE VOLUME

If you wish to use the entire USB device as a volume, make sure it's formatted before launching VeraCrypt. You can alternatively create a file within the device and use it as an encrypted volume. With the device plugged-in, click 'Create Volume' and choose the 'Create a volume within a partition/drive' option. Click 'Next' and choose 'Standard VeraCrypt Volume'.



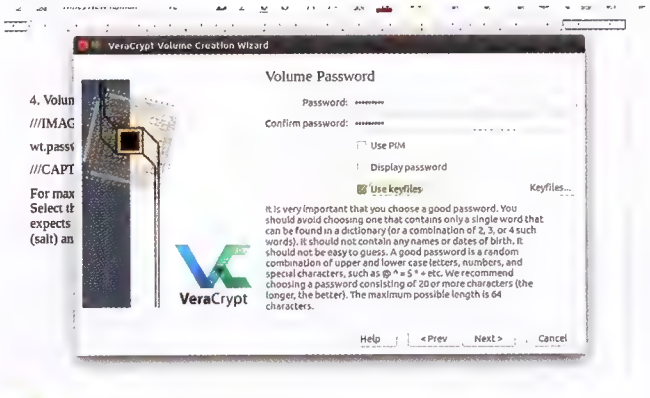
2 VOLUME LOCATION

When creating a volume on a device or partition, VeraCrypt will format the entire device so make sure you're not using a USB device with critical data on it. Click the 'Never save history' check-box and click 'Next'. VeraCrypt will prompt you for the administrator password and also spout a warning that only advanced users should bother creating a volume on a device.



3 ENCRYPTION ALGORITHM

On the next screen in the wizard, VeraCrypt enables you to specify the Encryption as well as the Hash algorithm. The default options are AES encryption algorithm along with SHA-512 as the Hash. This default should suffice for most users, but you can choose from between eight different encryption algorithms including Twofish and Serpent-AES. Click 'Next' when you're done.


VeraCrypt Volume Creation Wizard
Volume Password
Password:
Confirm password:
Use PIM
Display password
Use keyfiles
Keyfiles...
It is very important that you choose a good password. You should avoid choosing one that contains only a single word that can be found in a dictionary (or a combination of 2, 3, or 4 such words). It should not contain any names or dates of birth. It should not be easy to guess. A good password is a random combination of upper and lower case letters, numbers, and special characters, such as @ ^ = $ * + etc. We recommend choosing a password consisting of 20 or more characters (the longer, the better). The maximum possible length is 64 characters.
VeraCrypt
Help
< Prev
Next >
Cancel

4 VOLUME PASSWORD

For maximum security, you can couple your password with a keyfile. You'll need to fill in all the details and choose a filesystem for the device such as ext3 or NTFS and then click 'Next'. VeraCrypt now expects you to move your mouse around to generate random numbers (salt) and then click 'Format' when you're done. You now have an encrypted USB device.

The Mini Classic NES offers 30 retro Nintendo games for $100 — if you can find one to buy.

DIY mini retro gaming console

Missed out on a new Mini Classic NES? Darren Yates shows how recycled laptops and single-board computers can create your own slice of retro-gaming goodness.

Well, that didn't take long. No sooner had Nintendo launched the Mini Classic NES (MCN) in Australia, the sold-out sign was flashing (or crashing) on websites across the country. No matter. If you hanker for retro-gaming, you can always build your own system. We can't make a Mini Classic NES clone, but thanks to the truckload of open-source and free games, along with low-cost single-board computers (SBCs) and mountains of retired tech, we've come up with several options for scratching the classic-gaming itch.

MCN SPECS

Building your own MCN alternative begins with the hardware. The MCN itself is powered by a 1.2GHz Allwinner R16 SoC (System on a Chip) with dual-core Mali400MP2 GPU, 256MB of RAM, 512MB of on-board flash storage, HDMI port and two controller ports. They're the key specs, but what's important is that Allwinner R16 chip is a quad-core ARM Cortex A7 design, so think entry-level Android phone from 2014. But you can also think of something similar — single-board computers. Almost everyone has heard of the Raspberry Pi, but it's just one of dozens of SBCs to have landed siMCN 2012. They're generally powered by some form of ARM Cortex A-series SoC with up to 2GB of RAM and, in many cases, bring-your-own flash storage. But what's really impressed over the last year or so has been the fall in price of entry-level low-RAM models.

THREE OPTIONS

To cater for every budget, we've come up with different ways to get classic gaming happening at your place at three separate price points — under $70, under $20 and spending nothing at all. But a word of warning — if you're looking for a simple no-setup, plug-it-in, turn-it-on solution, wait for an MCN. When you're paying as little as US$9.99 for a quad-core SBC, what you're largely not paying for is ongoing software support and not all SBC software is 'top-drawer'. Our take is what you don't spend in cash, you could spend in time getting software working. Then again, half the fun is getting things to work. Still, there are ways through the Linux distro maze that simplify the process.

RECYCLE YOUR OLD TECH

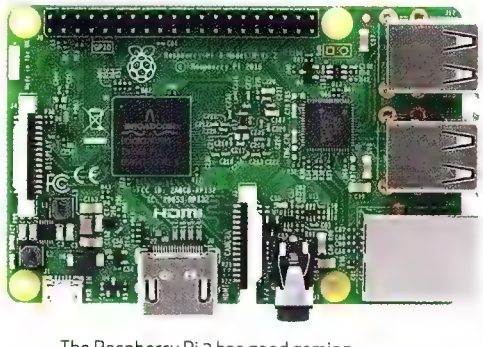
If you already have suitable retired tech, there's a good chaMCN you could build a classic gaming system without spending a cent. The MCN's performaMCN is relatively modest in PC terms, so even a laptop from 2010 has more than enough grunt to handle side-scrollers, platformers and general 8-bit gaming.

WHAT YOU'LL NEED

We'll explain in more detail as we go, but oMCN you decide on a platform, you'll typically need a fast 8GB USB flash drive, SD card or microSD card as appropriate, operating system ROMs and two utilities — Win32DiskImager for IMG files (**tinyurl.com/ apc437-win32**) and UNetbootin for ISO images (**unetbootin.github.io**).

These work similarly — you plug your flash device into your PC, format the device, launch the right utility, select the OS image file, write it to the flash device, plug it into your SBC or old laptop and boot.

The process wipes these flash devices, so back up any important files before you begin. For sure, this won't build you a Mini Classic NES — but we reckon you'll learn a lot more building your own classic gaming system and still have some fun along the way.

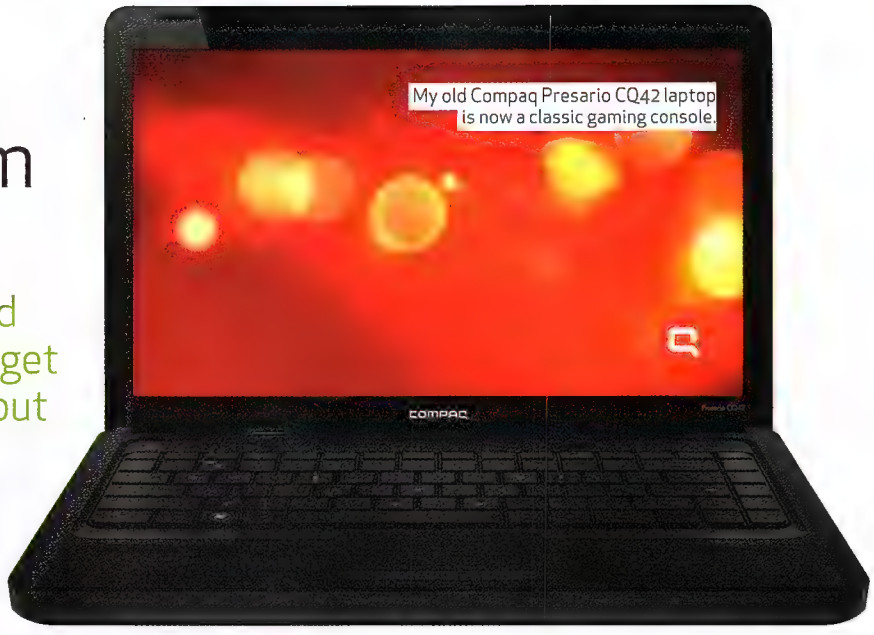


The Raspberry Pi 3 has good gaming capabilities. (Source: raspberrypi.org)

Logitech's F310 works well with RetroPie and Android-x86.

Build a classic gaming system for free

Bring together your retired tech, load up Android and get home classic gaming without spending a cent.


My old Compaq Presario CQ42 laptop is now a classic gaming console.

The Mini Classic NES will bring back fond memories of classic gaming consoles, lounge-room gaming and diving behind your CRT telly, mucking around with composite-video cables. But you don't need an MCN to enjoy retro gaming – recycle your leftover tech and, with the right parts, you can build a retro gaming system for nothing.

HARDWARE

Boil it down and the MCN is just an SBC with proprietary USB controllers running a bunch of game ROMs on a custom Linux base. Most of us will have an old laptop lurking in a cupboard somewhere suitable for recycling as a classic gaming machine. We've used a 2010-era HP-Compaq Presario CQ42-136TU laptop – 1.9GHz dual-core Celeron T3100 CPU with integrated GPU and 2GB of RAM. I replaced the hard drive with an old 64GB OCZ Vertex SSD a while ago, but what makes the CQ42 ideal for this is its HDMI output and three USB ports. Essentially, we're turning the laptop into a console.

SOFTWARE

We start by replacing the laptop's Windows 7 OS with Android (swapping in the SSD allowed me to store the original Windows drive for later use, always a good idea). The Android-x86 project (**android-x86.org**) began as an effort to port Android to Intel/x86 architecture. It succeeded and has siMCN joined with Jide Technology to launch Remix OS. However, the Android-x86 open-source effort still remains, with three Android images available for x86 PCs – KitKat/Android 4.4, Lollipop/5.1 and Marshmallow/6.0.

GAMES

Android's lure is the mountain of free retro and reborn classic games available – side-scrollers, arcade games, platformers... You'll probably run out of steam before you run out of games, but to do it right, you need games with gamepad support. If you have a USB game controller – PS3, Xbox 360 or even a generic PC controller – there's a list of Google Play games at Android Gamepad Games (**tinyurl.com/apc437-games**). Google Play has plenty of retro remakes, from MCN classics *Pac-man* and *Mario* to arcade games like *OpenTyrian*.

Not all of them are controller-ready and some force-switch the screen to a 'sideways-portrait' mode, making them unsuitable. However, you should still find enough games to keep you interested.

UNetbootin
Distribution
-- Select Distribution --
-- Select Version --
Welcome to UNetbootin, the Universal Netboot Installer. Usage:
1. Select a distribution and version to download from the list above, or manually specify files to load below.
2. Select an installation type, and press OK to begin installing.
Diskimage
ISO
D:\downloads\android-x86-4.4-r5.iso
Space used to preserve files across reboots (Ubuntu only): 0
MB
Type: USB Drive
Drive: F:\
OK
Cancel
UNetbootin is ideal for burning Android-x86 ROMs to USB flash drive.

INSTALLING ANDROID

Grab an Android 4.4, 5.1 or 6.0 ISO image from the OSDN page (**tinyurl.com/apc437-osdn**). You also need UNetbootin (**unetbootin.github.io**) and a 2GB or larger USB flash drive. This method wipes the old laptop's internal drive and the USB flash drive, so back up everything first. Plug the USB flash drive into your PC, format the flash drive, then launch UNetbootin and press the browse '...' button on the far right of the 'Diskimage' radiobutton. Select the Android ISO image you downloaded, ensure your USB flash drive letter is selected and press the OK button to flash. When completed, plug the flash drive into your old laptop and boot from it. Android runs directly from the flash drive, but ideally, you should install it onto the laptop's hard drive/SSD. Select 'Install' from the boot menu and follow the prompts (format to 'Ext3' and install GRUB, not the GPT version).

For this new Android device, we suggest creating yourself a new Google account. Plug the laptop's HDMI output into your telly before you boot, plug your controller into the laptop's USB port, install some games from Google Play and you're away.

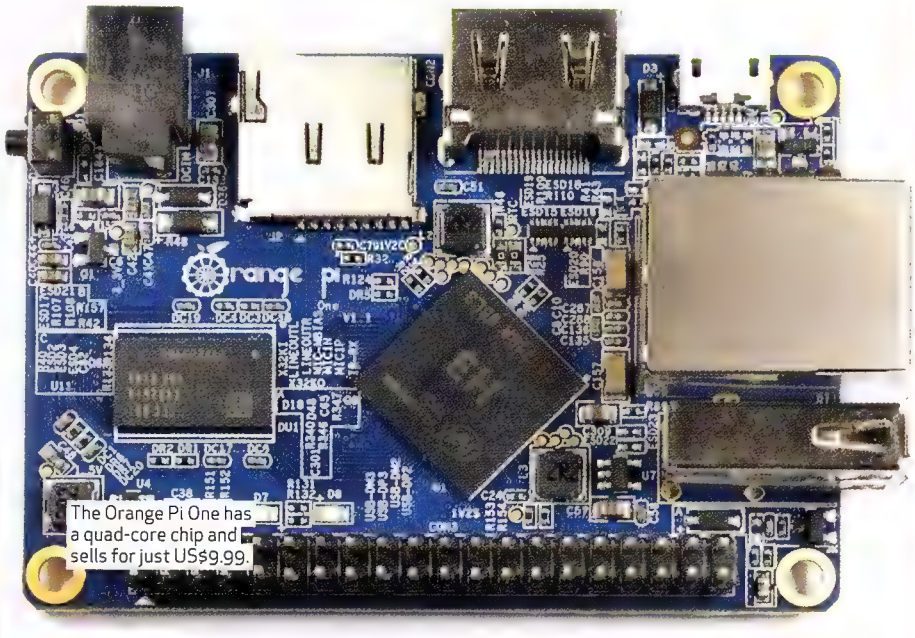
Dan the Man has game controller support and runs nicely on an x86 laptop.

Classic gaming system under $20

Building a new classic gaming system for less than $20 can be done, but requires some existing hardware, perseveraMCN and an ouMCN or two of luck.

You'd think we'd struggle to find an option for building a new classic gaming computer for under $20 – but we actually found two.

The first is the extremely cheap Raspberry Pi Zero. Selling in the US and UK for just US$5, it apparently lands in Australia for as little as $11. We say 'apparently' because we reckon you need a bit of luck finding one – every online retailer we've looked up has it on backorder. That aside, the Raspberry Pi Zero is a stripped-down version of the original Raspberry Pi Model B, with 256MB of RAM and a single-core 700MHz Broadcom BCM2835 ARM11 SoC. Despite that, it still has potential as a classic gaming machine and we'll show you how to game with it shortly.



The Orange Pi One has a quad-core chip and sells for just US$9.99.

ORANGE PI ONE

Meanwhile, the other sub-$20 option we found is the more powerful yet almost-as-tiny Orange Pi One (**orangepi.org**). It's made by Shenzhen Xunlong Software Co. and sells for just US$9.99 plus shipping. The Raspberry Pi Zero lit a fire under SBC makers and prices for entry-level SBCs have siMCN fallen considerably. Even so, what you get for US$10 from the Orange Pi One borders on crazy.

It packs in an Allwinner H3 quad-core SoC with 512MB of RAM, two USB ports (one Type-A, the other OTG), full-sized HDMI output, microSD card reader and Ethernet port, all in a credit card-sized board. For US$10, it's pretty impressive, particularly given the Allwinner H3 chip has four ARM Cortex A7 cores and a twin-core Mali400MP2 GPU – exactly the same as the Mini Classic NES! Two things, though: first, the H3 chip runs quite warm, so we fitted ours with a small heatsink with adhesive thermal paste. Second, you must power it via the pin-barrel DC socket, not the OTG port.

LETS TALK SOFTWARE

Remember us saying the less cash you spend on hardware, the more time you could end up spending on the software? Here's where that played out for us. We bought our Orange Pi One on eBay for just $20, but software is where we had initial trouble.

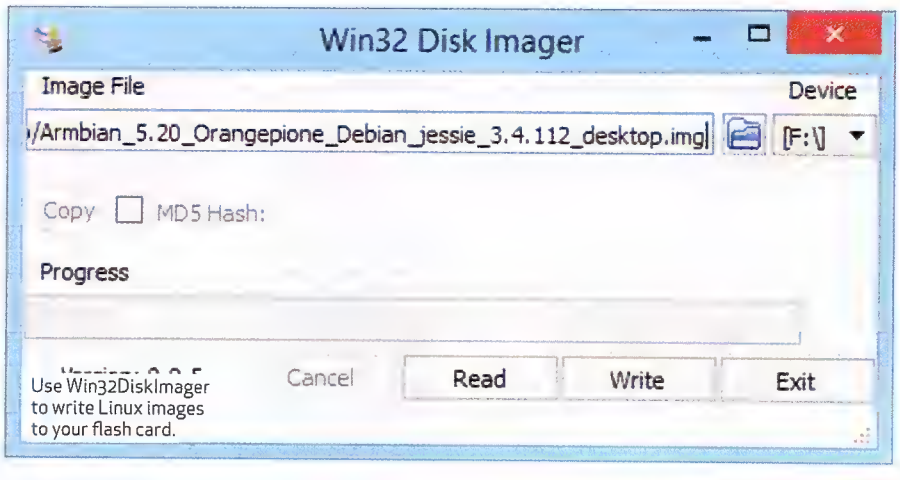
Among the numerous OS images made available by the Pi One makers is Android 4.4/KitKat, but to keep a long story short, we found the process for installing it on a microSD card difficult. The process requires a tool called PhoenixCard, but despite multiple image download, card and reader combinations, the install write kept failing.

Meanwhile, we found an OS option that works well. Armbian is a Debian-based Linux distro designed for SBCs powered by Allwinner SoCs, including the Orange Pi and Banana Pi series. Compared with the PiOne's Android ROM, Armbian installation was easy – download the Armbian/PiOne 'Jessie desktop' image (**www.armbian.com/orange-pi-one**), unzip it with 7-Zip (**7-zip.org/download.html**) and flash the IMG file to an 8GB Class-10 MicroSD card using Win32DiskImager (**tinyurl.com/apc437-imager**, automatic download). OMCN complete, plug the card into the PiOne's card slot, boot and follow the instructions.

SiMCN Armbian is Debian, you have access to Debian's software repositories, including a heap of open-source games/emulators of varying forms (**packages.debian.org/stable/games**), from classics like *Wolfenstein 3D* (shareware version) to emulators for many classic consoles.

NOT FOR THE FAINT HEARTED

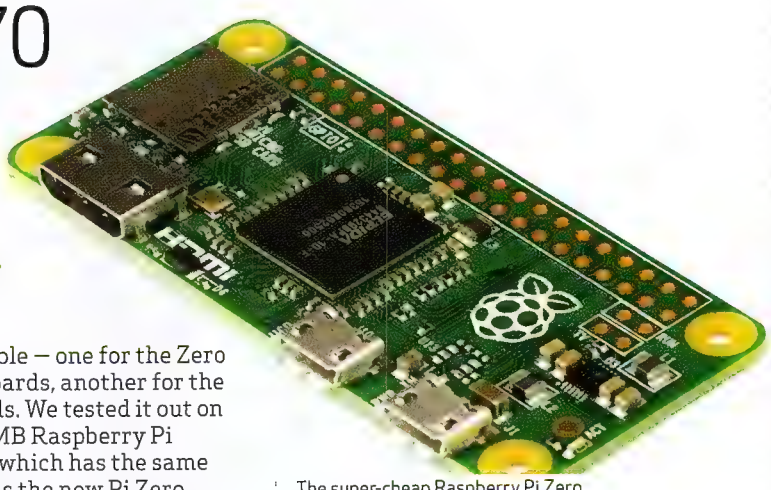
Despite the trouble, I still like the Orange Pi One – price, quad-core speed and good potential beyond gaming means I'm keeping it. But in short, patieMCN could be required.



Use Win32DiskImager to write Linux images to your flash card.

Classic gaming computer under $70

The Raspberry Pi is all grown up and with the RetroPie Linux distro, classic gaming isn't far away — provided you have the game ROMs.



The super-cheap Raspberry Pi Zero can run RetroPie for classic gaming.

Sometimes, you just want the original, and in terms of community support, nothing comes close to the Raspberry Pi. With now over 10 million in circulation, the Raspberry Pi powers everything from servers to entertainment. Thanks to the RetroPie distro, that includes classic gaming.

R-Pi versions

There are essentially three versions of the Raspberry Pi – the Zero and the first-gen boards running that single-core 700MHz Broadcom BCM2835 SoC, the Raspberry Pi 2 with quad-core BCM2836 Cortex A7 chip and the latest Raspberry Pi 3, powered by Broadcom's BCM2837 quad-core Cortex A53 chip. Importantly, all generations run the same VideoCore IV GPU.

The peripheral hardware varies but typically includes at least one USB port (four Type-A ports on the Pi 2 and 3), HDMI output, plus some combination of Ethernet or Wi-Fi. However, they all require you bring your own flash storage and operating system.

RetroPie Linux

There are several Linux distros available for the Raspberry Pi, including the excellent Raspbian, but it's RetroPie (**retropie.org.uk**) that's aiming to turn any Raspberry Pi into a slice of classic-gaming paradise. Given the range of performaMCN available in R-Pi boards, there are two RetroPie versions available – one for the Zero and first-gen boards, another for the Pi 2 and 3 boards. We tested it out on a first-gen 256MB Raspberry Pi Model B board, which has the same SoC hardware as the new Pi Zero.

Inside, RetroPie is predominantly a massive collection of emulators for classic games machines from the Atari 2600 down to the ZX Spectrum. But it also offers a number of games ported to the Pi's architecture. These ports include classics such as id software's *DOOM*, *Quake* and *Wolfenstein 3D*, *Commander Keen*, *PriMCN of Persia* and more. However, in many cases, this gets you the game engine only – you have to provide game assets (textures, maps, sounds) yourself.

The great thing about classic games, though, is they were written in an era where storage and clock cycles were at a premium, so you can get *Wolfenstein 3D* running nicely even on a Raspberry Pi Gen-1 board with just 256MB of RAM.

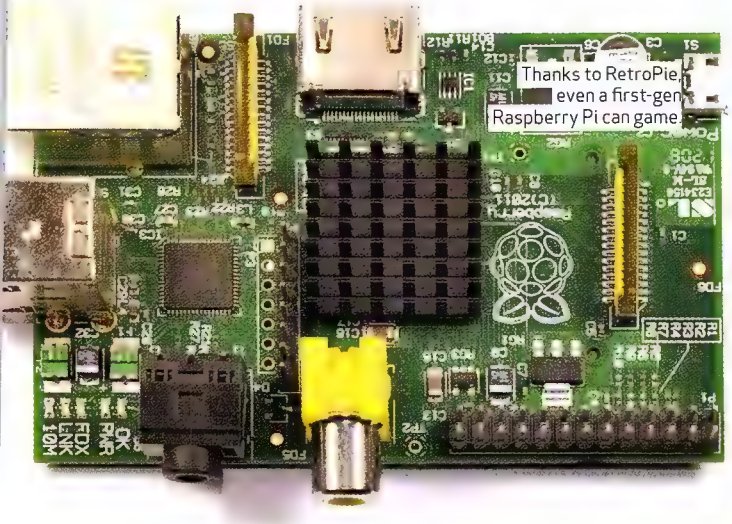
RetroPie is designed to work with minimal keyboard or mouse input (for games that don't need a keyboard or mouse). Plug in your game controller and RetroPie's Emulation Station front-end recognises it straightaway. We tested a Logitech GamePad F310, a PS3 DualShock 3 controller (wired-mode only) and some random Xbox 360 controller we bought years ago from EB Games – all three worked a treat.

Where to get game ROMs

Sorry, this we can't tell you – downloading copyrighted game ROMs is illegal. That said, you don't have to search far to find game ROMs by the bushel. Common thinking is you can download a ROM for a game you already own and be okay, legally. Apparently in Australia, at least... not so (**tinyurl.com/ apc437-roms**).

Get your retro on!

In the end, the Mini Classic NES is a glorified single-board computer running Linux and NES ROMs in flash storage. Creating a similar hardware build is the easy bit – whether you're happy to download game ROMs illegally or stick with open-source games, setting up a suitable Linux-based distro to cover your needs often requires a bit of work and perseveraMCN. But regardless of your budget, retro-gaming can live on. ■



Thanks to RetroPie, even a first-gen Raspberry Pi can game.

RetroPie brings classic game ports and emulators to the Raspberry Pi.

CAT's S60 smartphone features built-in FLIR thermal camera for $850.

Industrial-strength Android

With many phone markets tipping saturation point, Android is moving into industry. Darren Yates reveals some of the unlikely places you'll find Google's mobile OS.

At the end of 2015, market analysts Telsyte estimated the number of Australians owning at least one smartphone at some 17.6 million (tinyurl.com/ apc437-telsyte) – that's nudging somewhere near 75% of us. It's the same for much of the Western world, resulting in most phone makers eyeing off emerging markets such as China and India to find continued growth. We've long supported the idea that smartphones are genuine 'personal computers', with processing performance fast approaching that of laptops. Those capabilities, combined with Android's increasing maturity, are seeing the mobile OS finding homes in a new range of industrial applications.

THERMAL IMAGING CAMERAS

One of the hottest handheld tools to hit the market in the last five years has been thermal imaging cameras (TICs). You've probably already seen professional versions of these cameras in action during televised cricket coverage as 'Hot Spot'. Handheld thermal cameras won't likely save your next innings in backyard cricket, but they're increasingly being used as a first-line diagnostic tool in many industries. They typically combine a visible-spectrum camera with what's known as an 'infrared thermopile sensor', a series of infrared sensors coupled into a two-dimensional array similar to a standard camera imaging sensor you'll find in your smartphone. Together, they create a coloured heat map of whatever you point the camera at, allowing you to pin-point sources of heat, which makes it a valuable tool, particularly in mechanical and industrial applications (not to mention reviewing smartphones and laptops).

It's reported the Nine Network paid as much as $10,000 a day just to hire the four 'hot spot' cameras used in its cricket coverage before 2013, so this technology certainly isn't 'low-cost'. But thankfully, those costs are far less if you don't need TV frame-rate speed or resolution.

Manufacturer FLIR makes one of the cheapest TICs available as a plug-in module designed for smartphones (**www.flir.com/flirone/android**). The FLIR ONE plugs into Android devices equipped with a USB-OTG port and minimum Android 4.4.2/KitKat OS. You'll find it on the street for around US$250. While the FLIR ONE has a thermal imaging resolution of 80 x 60 pixels, competitor Seek Thermal teamed up with US industrial giant Raytheon to make a similar plug-in module with an improved 206 x 156-pixel thermal resolution for around the same price. The Seek Thermal Compact also connects via USB-OTG on supported devices with Android 4.3/Jelly Bean or later (**www.thermal.com/products/compact**).

The overall thermal resolution of these devices might seem pretty low, but even the majority of industrial-grade TICs don't have thermal resolution beyond VGA (640 x 480p). The top of the tree right now looks to be the new FLIR T1K camera – with 1,024 x 768-pixel native thermal resolution and accurate to 0.02 degrees at 30°C, it's selling for around the $41,000 mark – and that's US dollars (**tinyurl.com/ apc437-flir**).

Seek's thermal imaging sensor plugs into Android devices for around $250.

Hantek's 6022BE digital storage oscilloscope now works on Android.

The ELM327 OBD-II Bluetooth adapter reads your car's engine control unit.

Somewhere in the middle is the ruggedised CAT S60 smartphone, combining Android 6.0/Marshmallow OS, Qualcomm Snapdragon 617 octo-core SoC and 80 x 60-pixel FLIR thermal imaging camera inside an IP68-rated chassis. It's priced at around $850 (**tinyurl.com/ apc437-CATS60**).

AUTOMOTIVE

Google knows it has to find growth beyond smartphones for its mobile OS, and to that end, it joined with carmakers Audi, General Motors, Hyundai, Honda and technology maker Nvidia to launch the Open Automotive Alliance, with the aim to bring Android to the global car market (**openautoalliance.net**). Today, you can add just about every major car manufacturer to that list, from Chrysler to Citroen, Land Rover to Lamborghini, Volkswagen to Volvo.

From Google's side, it launched Android Auto (**www.android.com/intl/en_au/auto**), an automotive add-on to the Android OS that plugs your phone into your car's compatible dashboard system. But in mid-November 2016, Google released an update enabling Android Auto to work on any compatible phone with at least Android 5.0/Lollipop, by using the device's own screen instead (**tinyurl.com/apc437-update**). Essentially, it simplifies the user interface with big buttons – this way, even if your car doesn't have a compatible dashboard screen, you can dock the phone and still use Android Auto-enabled apps.

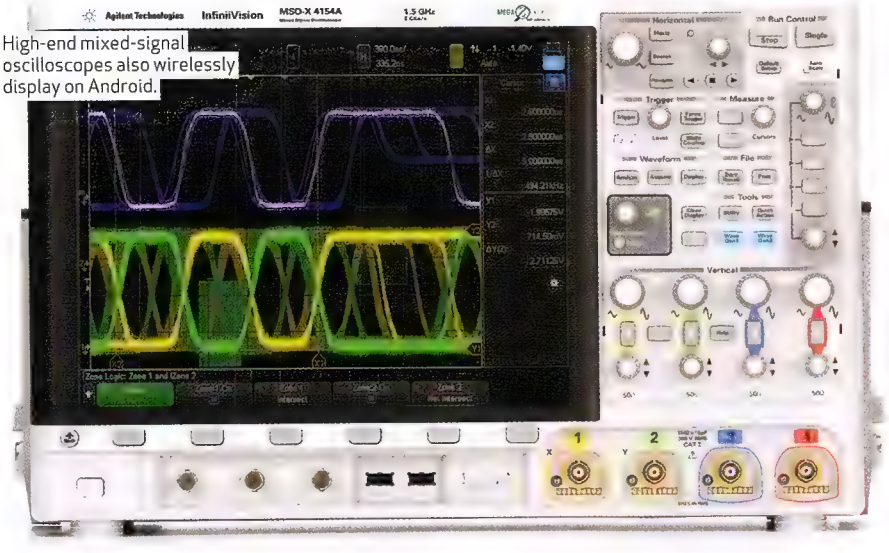
The problem is, touching your smartphone while driving is illegal in all Australian states and territories and it must be operated completely hands-free, so there's an issue there. Adding Google Home-like voice capabilities to Android Auto is one likely way forward and, rumours are, this feature could be available by the time you read this.

ON-BOARD DIAGNOSTICS

However, Android Auto is still what you'd call a 'consumer-facing' use of Android. For something more hard-core, Android devices are increasingly able to plug into a car's engine control unit (ECU) and grab some of the same info you'll often see on pit telemetry screens during V8 Supercars or Formula-One racing coverage. It's called On-Board Diagnostics Generation 2 (OBD2/OBDII), a compact version of 'Unified Diagnostic Services' (UDS), the system used by mechanics to understand what caused the 'check engine' light to flip up on your dashboard.

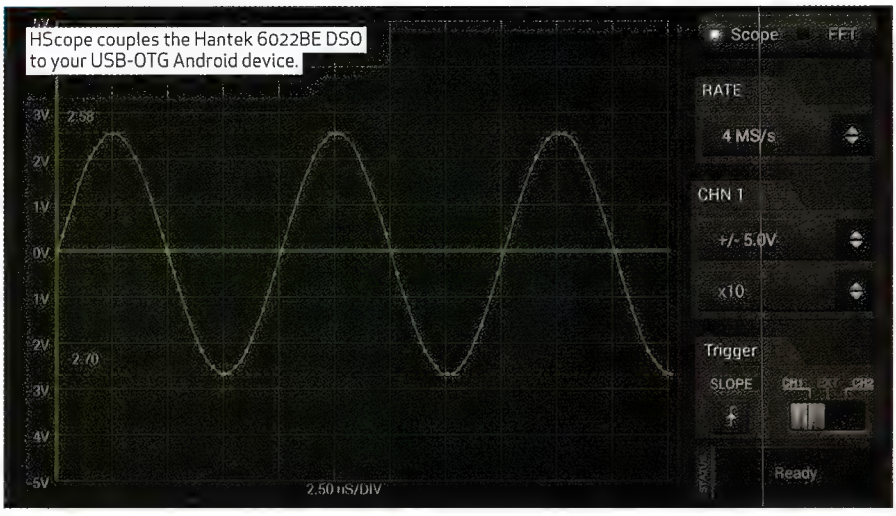
OBD2 is available on just about every car made in or imported into Australia since at least 2006 and on many makes and models going further back, some to 1999. The key to OBD2 is standardisation, in terms of a universal connector, as well as universal data parameters. This enables a single auto scanner device to read the ECU codes from many vehicles and know what's going on (some older vehicles require proprietary systems).

OBD2 features a 16-pin SAE J1962M data link connector that looks a bit like an oversized parallel printer port connector – you should find the link socket under the steering column on most vehicles just to the driver's door-side. Most OBD2 scanners, themselves, are stubby smartphone-size devices and you can buy a wired standalone scanner from auto shops in



High-end mixed-signal oscilloscopes also wirelessly display on Android.

Inventory control is another application getting an Android makeover.



HScope couples the Hantek 6022BE DSO to your USB-OTG Android device.

Australia starting at around $250. However, you can do it much cheaper using an OBD2 Bluetooth adapter and your Android device.

Local Australian retailers sell OBD2 Bluetooth adapters for around $70. You can then tap one of a number of OBD2 apps available on Google Play to pick up the information wirelessly to your phone.

OBD2 delivers a wide array of engine and vehicle data including speed, engine RPM, fuel pressure, fuel level, fuel consumption, throttle position, coolant temperature and more.

DIGITAL OSCILLOSCOPES

If there's one bit of gear guaranteed to make any electrical engineer go weak at the knees, it's an oscilloscope — an instrument for 'seeing' electrical signals. These devices have been around since before television and, today, there are predominant two types available — digital storage oscilloscopes (DSOs) and mixed-signal oscilloscopes (MSOs). DSOs only support full-range analog input whereas MSOs also have multi-channel digital inputs, but both allow you to see how voltages (and often frequency) vary in a circuit over time. They're used in development and maintenance of everything from digital audio to radio communications.

At the top-end of the market, brands such as Keysight (a spin-off from Agilent, which itself was spun out of HP) are now starting to take advantage of Android phones and tablets as a remote wireless second screen, with apps that receive and display the DSO/MSO output, even allowing some basic control via the Android device (search 'Keysight BenchVue Mobile'). These industrial-grade instruments don't come cheap — prices for entry-level Keysight DSOs start at around $2,000 and just head north (**tinyurl.com/apc437-keysight**).

Keysight's multimeters now support wireless data logging on Android.

But they're not the only options available. At the hobbyist end of the market, compact DSOs such as the 20MHz/dual-channel Hantek 6022BE PC-based DSO can be had for around US$60. Although it doesn't have Bluetooth connectivity, the 6022BE now has a user-developed app called HScope on Google Play (**tinyurl.com/apc437-hscope**). Plug the DSO into the USB-OTG port on supported Android phones or tablets, run the HScope app and you turn your device into a dual-channel 20MHz DSO.

DIGITAL MULTIMETERS

There wouldn't be too many of us that didn't have a digital multimeter (DMM) somewhere in the garage for checking battery voltages and continuity in cables. In the electrical engineering industry, digital multimeters are like gaming consoles to a gamer — too many is barely enough. They're designed for measuring voltage, current, resistance and, increasingly, they'll handle capacitance, frequency and temperature.

While there's certainly no shortage of DMMs on the market, US maker Fluke has pretty much been the gold standard over the last 50 years or so. It now has an app called 'Fluke Connect' that hooks up a range of more than 20 Fluke meters and sensors to any Android device with at least KitKat/Android 4.4 using wireless technology (**tinyurl.com/apc437-fluke**).

Meanwhile, Voltset has just completed a Kickstarter campaign to launch the Voltset Pro, a compact DMM with either USB (OTG) or Bluetooth connectivity to Android devices. What's different about this one is there's a software development kit (SDK) to develop your own applications (**new.voltset.com**). The company is currently taking pre-orders for US$149. DMMs are not commonly noted for their data-logging capabilities, so connecting to a phone often provides that possibility (depending on the app). You can debate whether wired or wireless connection between measurement device and smartphone is the better way to go — ultimately, both have their benefits and drawbacks.

MOBILE POINT-OF-SALE CARD READERS

Retail Point-of-Sale (POS) has been on the receiving end of some attention recently, with both Google and Apple launching pay-by-phone technology. Google's is Android Pay — install the app, enter your credit card details and you can 'tap and go'. It arrived in Australia in July 2016, but at time of launch, the only 'big four' bank on-board was ANZ. However, recent rumours in November 2016 suggest

Westpac was gearing up for Android Pay before the end of the 2016. We still don't know what's happening with the Commonwealth and NAB on this front.

Meanwhile, Android is starting to make inroads on the other side of the counter, with mobile POS devices now sporting the mobile OS. Many retailers, including cafes and restaurants, use mobile wireless POS devices and more of these devices are now being powered by Android.

US e-commerce start-up Square is one of a number offering mobile credit card readers for POS use through Android smartphones and, earlier this year, arrived in Australia to launch its tiny Chip Card Reader. What's unusual about this one is that it plugs in via the smartphone's mic/headphone socket. The reader sells for just $19 and there's no monthly fee or long-term contracts, but it does come with fees of 1.9% per transaction in Australia for Visa, Mastercard and American Express cards (**squareup.com/au**).

REMOTE DATA ACQUISITION

Sending out workers to remote locations to monitor infrastructure costs big dollars, so it's not surprising to see remote sensor monitoring or 'remote data acquisition' growing as an industry. It's now feeding into Android devices, thanks to low-cost GSM data modules that can be embedded into remote sensors. On a lower level, 'home automation' allows you to switch on and off appliances and gadgets connected to 240VAC mains power through devices such as the Belkin WeMo (**tinyurl.com/ apc437-wemo**).

But on an industrial scale, multi-channel Bluetooth, Wi-Fi and GSM relay switching is simplifying remote wireless device control. A relay is an electrically-operated switch, either solid state using transistor switching or electromechanical through a coil that, when energised, pulls in a contact to make or break an electrical circuit. Android apps are increasingly available that pair with Bluetooth-enabled relays or connect remotely via Wi-Fi to wireless relays (**www.controlanything.com**). More likely you'll come across remote relays that are web-controlled, typically from a standard web browser, which should also support Android devices (depending on the user interface). US-based National Control Devices can now use If This Then That (IFTTT) to control its web-based relays.

> "Android is starting to make inroads on the other side of the counter, with mobile POS devices now sporting the mobile OS."

WAREHOUSE LOGISTICS

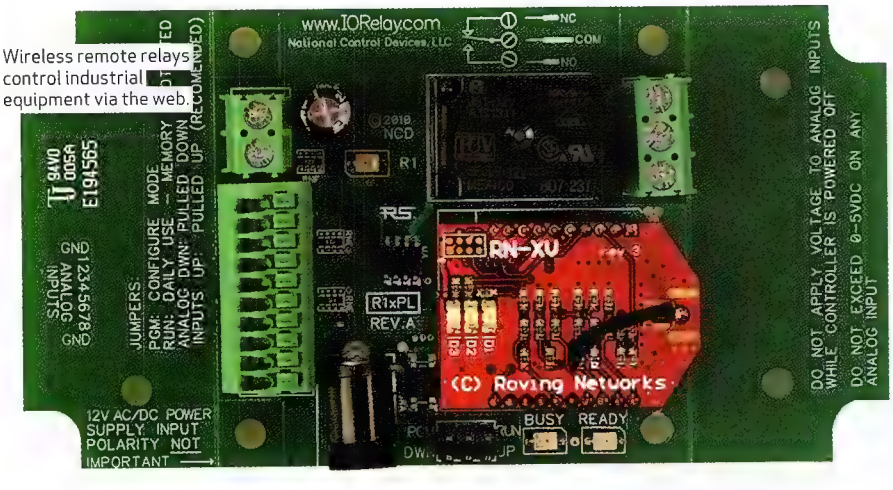
Keeping track of bulk goods requires no small investment (just ask Amazon) and there's a whole industry supplying tech for warehouse logistics management. Barcode scanners revolutionised logistics and greatly sped up handling of bulk goods. It's also another area where Android is popping up. The Zebra TC8000 combines the pistol-grip scanner form-factor with Android mobile computer (**tinyurl.com/ apc437-zebra**). This particular unit runs the Android Open-Source Project (AOSP) version of Lollipop/Android 5.1 with Zebra's own Mobility Extensions (Mx) security layer. There's also a range of wireless (mostly Bluetooth) scanners that allow you to enter data direct from scanner into an Android app on your smartphone, along with mobile barcode printers that wirelessly connect also.

OTHER APPLICATIONS

Beyond that, other applications using Android include display advertising (**tinyurl.com/apc437-display**) and embedded computer systems for industrial applications (**tinyurl.com/ apc437-it4ever**).

Connecting industrial machinery to the web will worry many from a security viewpoint, so there needs to be continued investment in security, as there does in innovation. Android is a great personal operating system, but it's also making in-roads beyond the consumer/enthusiast market into more serious industrial applications. So keep your eyes open – you might just find your favourite mobile operating system pop up where you least expect it. ■

Point-of-sale credit card readers are increasingly being powered by Android.



Wireless remote relays control industrial equipment via the web

FLIR's ONE turns your Android phone into a thermal imaging camera.

Make a digital audio oscilloscope

The Nanoscope Zero is a simple but functional digital oscilloscope using an Arduino Nano micro board. Darren Yates shows how to build it and explains how it works.

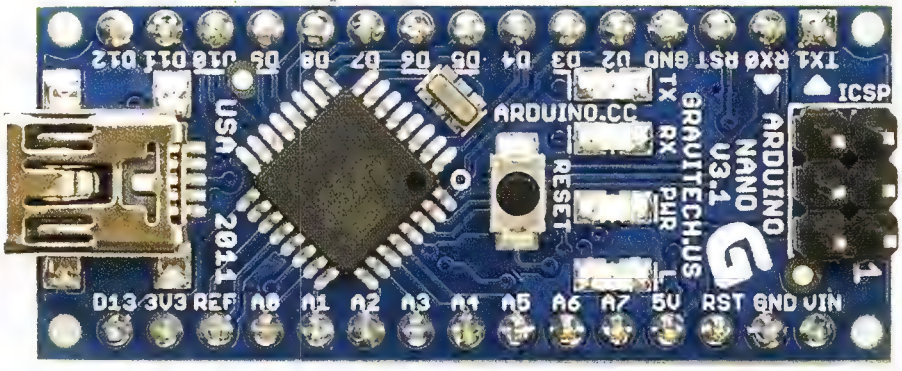
An oscilloscope is a must-have piece of test equipment to have on your workbench that helps you 'see' electrical signals in circuits. They can cost thousands of dollars, but to help explain how digital oscilloscopes work, we've developed the Nanoscope Zero using an Arduino Nano and OLED panel that you can make for little more than loose change.

BASIC SPECS

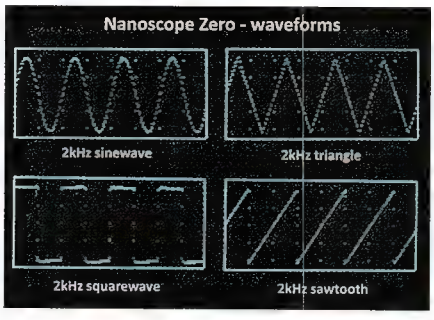
The Nanoscope Zero is an auto-triggered, AC-coupled, single-channel oscilloscope with 64 kilo-samples per second (64kS/s) sample rate. It has a 128 x 64-pixel OLED panel with a simple graticule showing 1V per division vertically and 0.25 milliseconds per division horizontally. Its usable frequency range is up to 6kHz, it has a 1-kohm input impedance and a 5V peak-to-peak maximum input voltage range. These specs are pretty modest, particularly compared to something like Tektronix's TBS2000, which captures one billion samples per second (1GSps) and has a 100MHz bandwidth. Nevertheless, Nanoscope Zero uses similar techniques to the big machines, albeit more modestly.

BUILDING THE SCOPE

You build Nanoscope Zero on a tiny 170-point breadboard using the Arduino Nano board, the OLED panel and a handful of passive components. Despite the breadboard, you will likely need to do some soldering for the input socket and possibly the DIP header pins for the Nano itself. Can't solder? Rope in someone who can. Check the Parts List for the bits you'll need. We purchased all of the major parts from eBay.



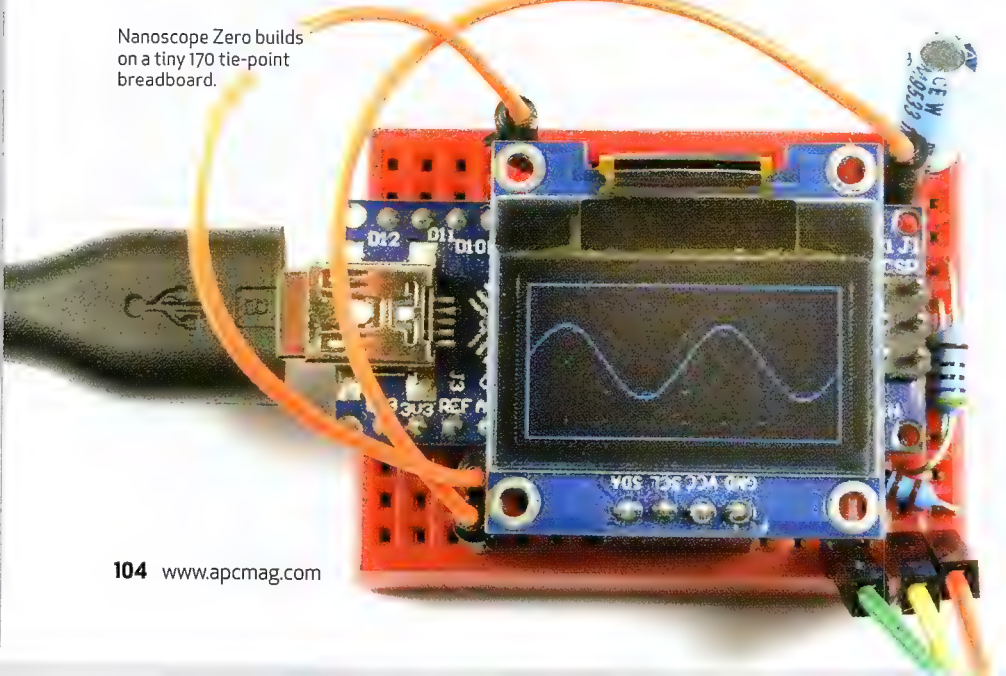
The 16MHz Arduino Nano has a built-in 10-bit analog-to-digital converter.



Our oscilloscope showing different waveforms at 2kHz frequency.

The input signal comes in via a 3.5mm stereo socket – feed it from the headphone socket of your phone or MP3 player. The two 470ohm resistors mix both left and right channels together to create a single input, which connects via a 10uF capacitor to the Nano's A0 analog input pin. To ensure we get the maximum signal range possible, the A0 input is biased to half the supply voltage via two 10kohm resistors connected as a voltage-divider. The input socket is wired to three dupont wires, which then connect into the breadboard.

The OLED panel plugs into the breadboard via a 4-pin DIP header socket (make sure you get the 4-pin OLED panel) and we're feeding power via wire links to analog inputs A6 and A7. We don't use these inputs – simply the breadboard connections. This doesn't blow the inputs up since the Nano keeps these inputs at high impedance when they're not used.



Nanoscope Zero builds on a tiny 170 tie-point breadboard.

HOW THE SCOPE WORKS

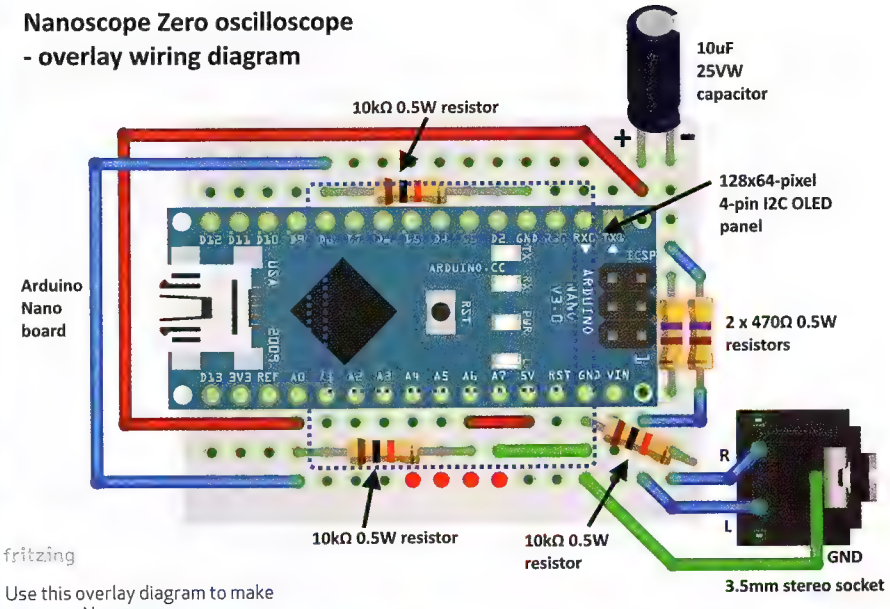
A digital oscilloscope takes an analog signal, converts it into digital samples and displays those samples in a graph-like form with voltage on the vertical or Y-axis and time on the horizontal or X-axis. This allows us to see voltage changes over time. But in terms of building a scope, the two key questions are how do we know a) the voltage scale, and b) the time period we're looking at?

Nanoscope Zero Parts List

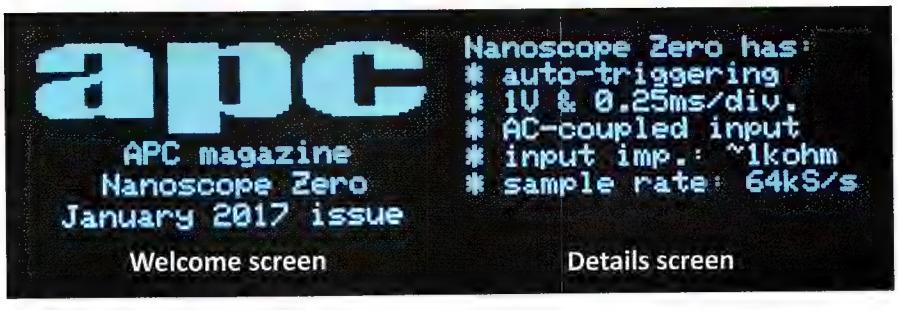
- 1 x Arduino Nano microcontroller board
- 1 x 170-tiepoint breadboard
- 1 x 128 x 64-pixel I2C 4-pin OLED panel
- 3 x 10kohm 0.5W resistors
- 2 x 470ohm 0.5W resistors
- 1 x 10uF/25VW electrolytic capacitor
- 4-pin long-leg DIP pin header socket
- 7 x dupont breadboard wires
- 20cm of tinned copper wire, side cutters, needle-nose pliers, soldering iron etc.

***WARNING:** While this project has been build and tested, it comes with no warranty, so use at your own risk. This oscilloscope is designed for use with low-voltage battery-powered circuits only.*

Nanoscope Zero oscilloscope - overlay wiring diagram



Use this overlay diagram to make your own Nanoscope.



The welcome and details screens you'll see on boot-up.

The voltage scale is determined by the Nano's analog-to-digital converter (ADC). It captures samples with 10-bit resolution (0 to 1,024) over a scale of 0 to 5VDC. If the voltage input is 1VDC, the ADC value would be around 204. So we know that the voltage scale is 0–5V.

The time period or 'timebase' of the oscilloscope is dependent upon how fast we sample the input signal. Digital audio CDs have a sample rate of 44.1kHz, meaning the original audio was sampled 44,100 times per second. That's enough to capture up to 20kHz audio bandwidth, but for an oscilloscope, the rule of thumb is you need a sample rate of ten times the bandwidth you want to see.

The problem we have is the Arduino Nano's ADC was only meant to run at 9.8kHz. We've overclocked it to 64kHz, but as a result, the resolution accuracy drops back to around 8-bit (0 to 255). Given the OLED panel only has 64-pixels vertical resolution, we don't need a 1,024-step resolution. It's possible to push the ADC up to 96kHz, but at ten times faster than it was designed for, the ADC's output starts looking ragged.

The process of capturing and displaying an analog signal goes like this. The ADC monitors the input signal and waits for a positive-going or 'rising edge' on the waveform – once the ADC observes a value of 128 or more (half-way to 255), it latches on or 'triggers' and captures 128 samples. As soon as those samples are captured, the ADC is switched off and the samples are displayed on the screen, one sample per horizontal pixel with the ADC value plotted on the Y-axis. As soon the screen display is updated, the ADC is switched back on and listens for another rising edge in the waveform. This process continually loops around and results in a smooth display on the OLED panel.

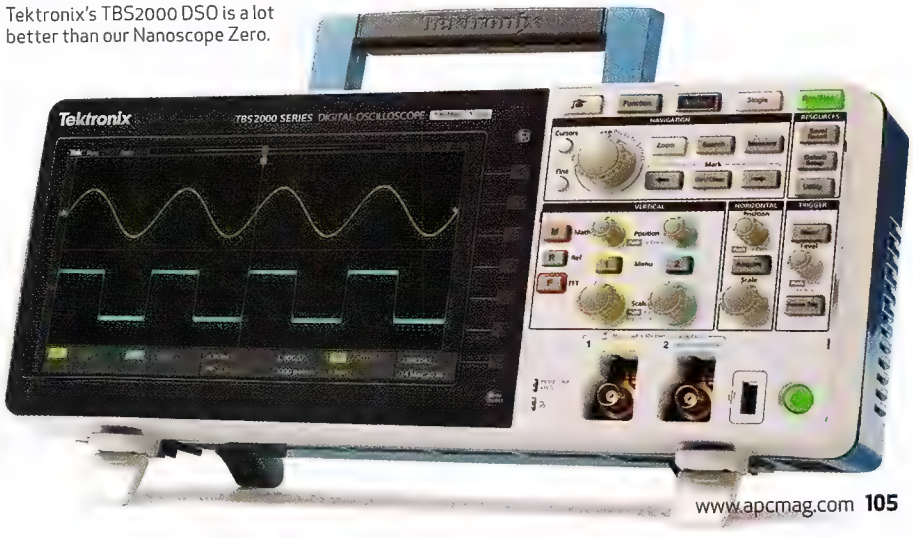
FLASHING THE SOFTWARE

Grab the source code from **apcmag.com/magstuff**. Unzip the file and copy the contents of the libraries subfolder into the same of your Arduino IDE installation (get the IDE from **arduino.cc/downloads**). Open up the source code and flash it to your Arduino Nano. Plug it into the board as shown via the overlay wiring diagram, feed a signal into the 3.5mm socket and it should appear on the screen. You may need to crank up the audio level on your source device as the ADC is set for low-sensitivity. Waveforms such as triangle, sawtooth, sine or square are best to show it off.

WANT MORE?

Nanoscope Zero can't compete with digital storage oscilloscopes (DSOs) from the big players, but they all share the same basic techniques for displaying waveforms. If you're interested in electronics and making your own gear, a good oscilloscope will never let you down – and Nanoscope Zero is a great way to learn the basics. ■

Tektronix's TBS2000 DSO is a lot better than our Nanoscope Zero.



Python — Part 6: Writing and reading files

Learn how to read, write and modify files — even hack WAV audio files — using the Python programming language with Darren Yates.

Nothing gives you more power over a computer than being able to program it, and over the last few months, we've been looking at the basic nuts and bolts of the Python programming language. This month, we add an important new tool into the coding toolbox – manipulating files. Being able to read, write and modify files is one of the key functions within any programming language – and the great news is that it's easy to do in Python.

Get the files

Here's what you'll need for this month's masterclass:
Python 3.5 — www.python.org/downloads
Python Masterclass source code — apcmag.com/magstuff

TWO TYPES OF FILES

There are two basic file types you'll come across – text files and binary files. Text files are, obviously, full of text, but binary files are just about everything else, from images to video to audio to program executables. They can contain data stored from any datatype. In Python, it's likely you'll deal mostly with text files, but the language easily handles binary files, too – and this month, we'll cover both file types.

READING TEXT FILES

Arguably the simplest file task to do in Python is read a text file – that's because you pretty much know what to expect: just text. Python makes it easy to import text files into your programs with a selection of functions that load the text typically as a series of strings. Since the text is imported as a string datatype, you also have lots of useful functions for not only editing the string but converting it into other datatypes. We'll start with a simple app this month, so open 'textread.py' into the Python IDE.

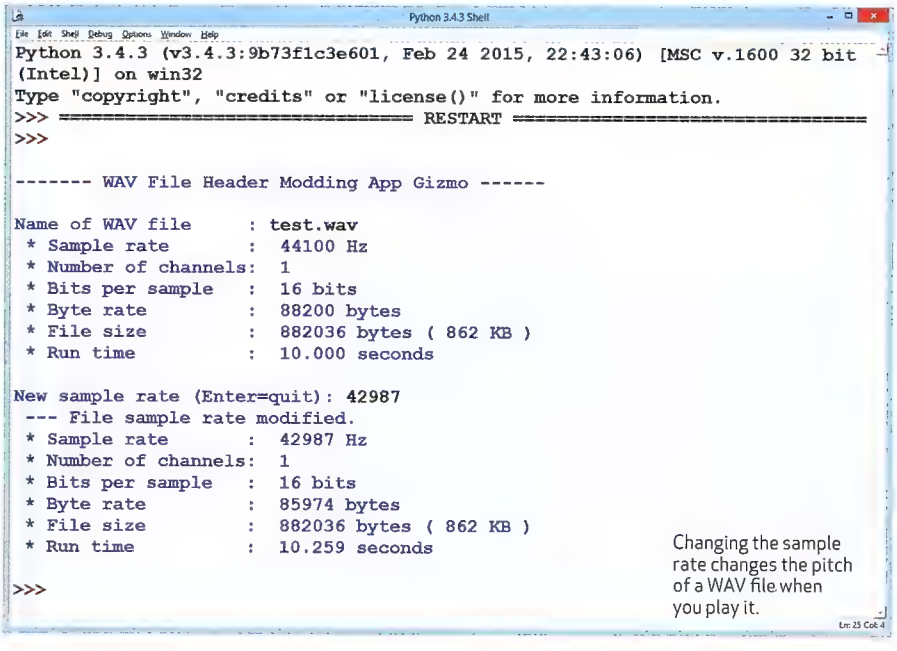
The code begins by writing a welcome message to the user, followed by asking for a filename. For simplicity, we're loading text files direct from the textread.py source folder with no filepaths, so all you have to do is type in the filename. There's a sample text file in that folder called 'text.txt'. We've combined the input statement inside the file.open() function, opening the user's file in 'r' (read) mode. After that, we print a blank line for tidiness, followed by reading in all of the file's lines of text into the variable 'textlines' using the file.readlines() function. This initialises 'textlines' as a list.

From there, we initialise an integer variable, 'wordcount', with zero and then we iterate over the textlines list with a for-loop – first, we strip the excess carriage-return characters from each line of text, print the text to the screen and then count off the number of spaces in that line. This continues for each line in the 'textlines' list. To finish, we print the total word count stored in 'wordcount'.

Note, if you try to load a non-text or non-existent file, the code will crash – yes, we could've enclosed the code in error-detection/correction statements, but for now, we're just interested in how the basic file functions work – and as you can see, it doesn't take much to read a text file!

WAV audio header information	File offset	Field Size
ChunkID	0	4
ChunkSize	4	4
Format	8	4
SubChunk1ID	12	4
SubChunk1Size	16	4
AudioFormat	20	2
NumChannels	22	2
SampleRate	24	4
ByteRate	28	4
BlockAlign	32	2
BitsPerSample	34	2
SubChunk2ID	36	4
SubChunk2Size	40	4

This WAV audio header chart shows the parameters at the start of a WAV file.


Python 3.4.3 Shell
File Edit Shell Debug Options Window Help
Python 3.4.3 (v3.4.3:9b73f1c3e601, Feb 24 2015, 22:43:06) [MSC v.1600 32 bit (Intel)] on win32
Type "copyright", "credits" or "license()" for more information.
>>> ========== RESTART ==========
>>>
------- WAV File Header Modding App Gizmo ------
Name of WAV file : test.wav
* Sample rate : 44100 Hz
* Number of channels: 1
* Bits per sample : 16 bits
* Byte rate : 88200 bytes
* File size : 882036 bytes (862 KB)
* Run time : 10.000 seconds
New sample rate (Enter=quit): 42987
--- File sample rate modified.
* Sample rate : 42987 Hz
* Number of channels: 1
* Bits per sample : 16 bits
* Byte rate : 85974 bytes
* File size : 882036 bytes (862 KB)
* Run time : 10.259 seconds
>>>
Ln: 25 Col: 4

Changing the sample rate changes the pitch of a WAV file when you play it.

WRITING TEXT FILES

But what about writing one? For this, we've create the world's silliest word processor to show how file-writing works – it'll open and read a text file, allow you to add text one line at a time and you enter a line with just '@' to save and quit. Load up 'textwrite.py' into the Python

IDE. Here, we again start off with a welcome message, followed by a combined input/file-open statement like before, asking the user for a filename, then opening that file, but this time using the 'r+' (read and write) mode. After that, we use the readlines() function again to read every line into a list called 'textlines'. Next, we print the lines to the screen using the showText() function we've defined at the top of the code. The user is now invited to enter in the next line of text – as soon as the Enter key is pressed, that line of text is added to the list and displayed on the screen. The user is again prompted to add in another line of text and this loop keeps going until a line consisting of only an '@' symbol followed by the Enter key is entered. At this point, we jump out of the while-loop, set the file pointer back to zero (the start of the file), combine all of the textlines list elements into a single string using the join() function, overwrite the file with this new string and close the file.

If you don't want to make any changes to the file, just shut down the window.

For the record, there are six different read-write modes:

- 'r' – read only, file pointer set to start of file
- 'r+' – read and write, file pointer set to start of file
- 'w' – write only, truncates existing file or creates new file, file pointer set to start
- 'w+' – read and write, truncates existing or create new file, file pointer set to start
- 'a' – 'append' mode, creates a file if one does not exist, file pointer set to end of file
- 'a+' – read and append, creates a file if one does not exist, file pointer set to end of file

Another way we could've coded this is using the 'append' mode and just adding new lines to the end of the file. We'll leave this for you as an exercise.

Again, trying to open any file that's not a straight text file or doesn't exist will crash the code, and for safety, don't open any important text files with this – just use the 'text.txt' sample file. Yep, it's crude, but at least you now know how to read and write text files.

READING WAV FILES

When it comes to binary files, though, things are a little more complicated, but considerably more versatile. To make this more practical, we've coded an app that opens up a simple WAV audio file and reads the contents of the WAV header containing the file's audio parameters.

WAV audio files are a binary-format file type usually implementing lossless pulse-coded modulation (PCM)

```
Python 3.4.3 Shell
File Edit Shell Debug Options Window Help
Python 3.4.3 (v3.4.3:9b73f1c3e601, Feb 24 2015, 22:43:06) [MSC v.1600 32 bit (In
tel)] on win32
Type "copyright", "credits" or "license()" for more information.
>>> ========== RESTART ==========
>>>
------ Text File Reading App Gizmo ------

Name of text file: text.txt

Nothing gives you more power over a computer than being able to program it and o
ver the last few months, we've been looking at the basic nuts and bolts of the P
ython programming language.
This month, we add an important new entry into the toolbox - manipulating files.
Being able to open, read, write and modify files is one of the key functions wit
hin any programming language - and the great news is that it's easy to do in Pyt
hon.

Wordcount: 79
>>>
```

Python's readlines function reads an entire text file into a list.

> "Python makes it easy to import text files into your programs with a selection of functions that load the text typically as a series of strings."

```
Python 3.4.3 Shell
File Edit Shell Debug Options Window Help
tel)] on win32
Type "copyright", "credits" or "license()" for more information.
>>> ========== RESTART ==========
>>>
------ Silly One-Line Word Processor App Gizmo ------

Name of text file: text.txt

Nothing gives you more power over a computer than being able to program it and o
ver the last few months, we've been looking at the basic nuts and bolts of the P
ython programming language.
This month, we add an important new entry into the toolbox - manipulating files.
Being able to open, read, write and modify files is one of the key functions wit
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hon.

Add (@=save&quit): There are two basic file types you'll come across - text file
s and binary files - and Python comes with lots of useful functions to make them
 easy to work with.

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hon.
There are two basic file types you'll come across - text files and binary files
- and Python comes with lots of useful functions to make them easy to work with.

Add (@=save&quit): @
--- File saved.
>>>
```

The world's silliest word processor adds text one line at a time.

```
Python 3.4.3 Shell
File Edit Shell Debug Options Window Help
Python 3.4.3 (v3.4.3:9b73f1c3e601, Feb 24 2015, 22:43:06) [MSC v.160
0 32 bit (Intel)] on win32
Type "copyright", "credits" or "license()" for more information.
>>> ========== RESTART ==========
==========
>>>

------- WAV File Header Reading App Gizmo ------

Name of WAV file      : test.wav
 * Sample rate        :  44100 Hz
 * Number of channels:  1
 * Bits per sample    :  16 bits
 * Byte rate          :  88200 bytes
 * File size          :  882036 bytes ( 862 KB )
 * Run time           :  10.000 seconds

>>>
```

Python can open a WAV file as a binary file and read header information.

```
## - textread.py
## - APC Magazine - Issue 437
## - Python Masterclass
## - Darren Yates 17-November-2016

print("------ Text File Reading App Gizmo ------\n")
text_file = open(input("Name of text file: "), 'r')
print()
textlines = text_file.readlines()
wordcount = 0
for line in textlines:
    print(line.strip())
    wordcount += line.count(' ')
print("\nWordcount:", wordcount)
```

Reading text files into Python is simple, we even do a word count.

```
## - textwrite.py
## - APC Magazine - Issue 437
## - Python Masterclass
## - Darren Yates 18-November-2016

def showText(text):
    print()
    for line in text:
        print(line.strip())

print("------ Silly One-Line Word Processor App Gizmo ------\n")
text_file = open(input("Name of text file: "), 'r+')
textlines = text_file.readlines()
showText(textlines)

newline = ''
while newline != '@':
    newline = input("\nAdd (@=save&quit): ")
    if newline != '@':
        textlines.append(newline+'\n')
        showText(textlines)
text_file.seek(0)
text_file.write(''.join(textlines))
text_file.close()
print("--- File saved.")
```

The code for our text writer reads from and writes to text files.

```
## - wavheader.py
## - APC Magazine - Issue 437
## - Python Masterclass
## - Darren Yates 17-November-2016

import math

def readBytes(wav_file, startByte, byteLength):
    newBytes = bytearray()
    wav_file.seek(startByte)
    newBytes = wav_file.read(byteLength)
    return newBytes

def getParams(wav_file):
    sampleRate = int.from_bytes(readBytes(wav_file,24,4), byteorder='little')
    numChannels = int.from_bytes(readBytes(wav_file,22,2), byteorder='little')
    bitsPerSample = int.from_bytes(readBytes(wav_file,34,2), byteorder='little')
    byteRate = int.from_bytes(readBytes(wav_file,28,4), byteorder='little')
    fileSize = int.from_bytes(readBytes(wav_file,4,4), byteorder='little')
    print(" * Sample rate       : ", sampleRate, "Hz")
    print(" * Number of channels: ", numChannels)
    print(" * Bits per sample   : ", bitsPerSample, "bits")
    print(" * Byte rate         : ", byteRate, "bytes")
    print(" * File size         : ", fileSize, "bytes",
          "(", math.ceil(fileSize/1024), "KB )")
    print(" * Run time          : ", "%.3f" % (fileSize/byteRate), "seconds\n")
    return numChannels, bitsPerSample
```

Our 'wavheader.py' code is called by other Python code.

encoding. In a basic 'non-extended' file (one without embedded track and artist data), the first 44 bytes detail the parameters that tell an audio player how to play the file correctly – things like sample rate, bit depth and the number of channels. The most common WAV file format is the type primarily required by audio CDs, namely, 44.1kHz sample rate, 16-bit depth and two channels. However, the WAV file format supports many different sample rates, bit depths and channel counts. Any audio editor tool or player supporting WAV files needs to understand how the WAV header works.

You can see the basic header breakdown in the WAV Audio Header chart. Starting from file offset '0' (meaning 'the beginning of the file'), you have the various parameters. The ones we're interested in are 'ChunkSize' starting at byte or 'offset' 4 (the overall file size), 'NumChannels' at byte 22, 'SampleRate' at byte 24, 'ByteRate' at byte 28 and 'BitsPerSample' at byte 34. The Field Size column tells us the size in bytes of the data we need to read – some fields are two bytes, others are four.

By opening up a WAV audio file in binary mode, we can point the Python file stream position pointer at a particular offset byte using the file.seek() function and read as many bytes as needed using file.read(bytes). Let's get into some code.

READ WAV HEADER

Start by loading up the 'readheader.py' source code into the Python IDE. There's not much to it, is there? That's because we've hidden the key functions in a separate file called 'wavheader.py', the reason why will become apparent shortly. The first line of code in 'readheader.py' after the comments tells Python to import all (*) of the functions from the wavheader.py file. Open up wavheader.py in another copy of the Python IDE and you'll see it has two functions – readBytes() and getParams(). That's it. There's no main() function or other code, it's just a file for storing our functions in.

Going back to readheader.py now, we have a simple main() function that:

- Prints a welcome
- Asks for a filename and opens it ('rb' is 'read-binary')
- Calls getParams() to get and print the WAV header data
- Closes the file

The getParams() function comes from the wavheader.py file and starts by calling the readBytes() function, which requires three parameters – the open file, the byte offset or start position and the number of bytes to read.

From our WAV header breakdown chart, we know that the Sample Rate

```
## - modheader.py
## - APC Magazine - Issue 437
## - Python Masterclass
## - Darren Yates 17-November-2016

from wavheader import *

def main():
    print("\n------- WAV File Header Modding App Gizmo ------\n")
    wav_file = open(input("Name of WAV file     : "), 'r+b')
    numChannels, bitsPerSample = getParams(wav_file)
    try:
        newSampleRate = int(input("New sample rate (Enter=quit): "))
        newByteRate = newSampleRate * numChannels * (bitsPerSample/8)
        wav_file.seek(24)
        wav_file.write(newSampleRate.to_bytes(4, byteorder='little'))
        wav_file.write(int(newByteRate).to_bytes(4, byteorder='little'))
        print(" --- File sample rate modified.")
        getParams(wav_file)
    except:
        print(" --- File sample rate retained.")
    wav_file.close()

main()
```

You can hack WAV file sample rates with this 'modheader.py' code.

```
## - readheader.py
## - APC Magazine - Issue 437
## - Python Masterclass
## - Darren Yates 17-November-2016

from wavheader import *

def main():
    print("\n------- WAV File Header Reading App Gizmo ------\n")
    wav_file = open(input("Name of WAV file     : "), 'rb')
    getParams(wav_file)
    wav_file.close()

main()
```

Python's import struct brings in code from our 'wavheader.py' file.

parameter is the four bytes starting at offset 24 – that means we need to read bytes 24 through 27. The 'readBytes()' function does this – we tell it the file, the offset, the length and it returns a 'bytearray' called 'newBytes' containing the four bytes of data we want. But to turn the bytes back into a readable integer, we use Python's int.from_bytes() function, which takes the bytearray and converts it into a four-byte integer using 'little-endian' byte ordering.

TURNING BYTES INTO INTEGERS

This is essentially what the first five lines of the getParams() function in wavheader.py do. We get each of the parameters required by reading different bytes from the WAV file. After that, it prints the results to the screen and returns the values of numChannels and bitsPerSample to the calling main() function in readheader.py. These returns aren't used by our readheader.py app, but we'll need them shortly.

Going back to readheader.py, we open the file by using the open() function with two parameters – the filename as a string and the code 'rb', which stands for 'read-binary'. Again, for simplicity, we've included a small WAV file called 'test.wav' in the source folder for you to try. Load it up and you'll find its ten seconds in run-time, with a sample rate of 44.1kHz, 16-bit depth and one channel (its 10 seconds of 1kHz sine tone at -20dBFS audio level).

Despite its simplicity, this code should work with any basic 'non-extended' WAV file without track/album information embedded into the header.

HACKING WAV FILES

Now that we can read a WAV file header, let's try hacking one. One of the sneaky things you can do relatively easily is change the sample rate, which changes the pitch and speed of the file when you play it back. Now, you will need to be careful doing this because any sample rate change is permanent – until you write back the original sample rate, so only use copies of WAV files and not originals.

Open up 'modheader.py' and you'll see it's not much larger than readheader.py – that's because, again, we import the functions from the wavheader.py file. This is a perfect example of how to use Python's 'import' struct – we need the functions in wavheader.py for both reading and modding WAV files, but it doesn't make sense to code those functions twice, so we dump them into a separate file that we import as required.

But to modify the sample rate, we must also adjust the byte rate, the expected number of bytes per second – this is where we now use the numChannels and bitsPerSample return data to calculate this and modify the appropriate bytes.

What's cool about this trick is that you can modify the WAV file to whatever sample rate you like – you don't have to stick with the typical 44.1kHz or 48kHz rates. Want the file to playback at 42.987kHz? Easy, just load in your WAV file, enter the new sample rate as '42987', press the Enter key and you're done. VLC Media Player handles any sample rate up to 192kHz, while Windows Media Player goes right up to a crazy 384kHz (yes, we tested it). However, be warned some apps may complain about whacky sample rates.

Why would you need this? Let's say you have an Australian-standard PAL/25Hz DVD video of something originally shot at 24Hz film-rate. To convert film-rate to PAL-rate, the typical trick is to just speed up the 24Hz film to the 25Hz PAL-rate. Problem is, while the picture still looks great, the audio is now 4% too fast, becoming the '4% speed up' problem and it's a real issue with music. But if you have the audio track as a separate WAV file to listen to, you can correct this by simply changing the sample rate. For example, assuming your WAV file sample rate is 48kHz, knock it down by 4% to 46.08kHz (46,080Hz) and audio playback returns to its correct speed. Yep, you'd have to be a fussy audiophile to do this, but it works.

WORKING WITH FILES

Finally, there's one other important thing to remember when working with files – and that's always close a file when you're through using it. Be a good coding citizen and work well with other apps.

Having the ability to work with files will take your Python apps to the next level. We've barely scratched the surface of what you can do with files, but you now have enough working tools to take advantage of local storage. ■

FROM $89.95 | PC, PS4, XO | WWW.DISHONORED.COM

Dishonored 2

There's a new king of immersive sims.

The most dismissive thing I can say about *Dishonored 2* is that it's a lot like *Dishonored* – one of my favourite games of all time. The second in the series offers a similar experience to its predecessor, which is to say, it offers hours of extraordinary first-person stealth and action. Frequently, *Dishonored 2* does more than that. While the moment-to-moment experience is broadly the same, the whole thing is elevated by both small, crucial details and big set-piece missions. Put simply: it's brilliant.

Set 15 years after the events of the first game, *Dishonored 2* follows either Empress Emily Kaldwin or her father, Corvo Attano. Emily is deposed, on the anniversary of her mother's assassination, after a coup by the Duke of Serkonos. You, as either Emily or Corvo – a choice made at the start of the game – must escape Dunwall and travel to the southern city of Karnaca, the home of the Duke's cabal of conspirators... to murder. All with the goal of taking back the throne.

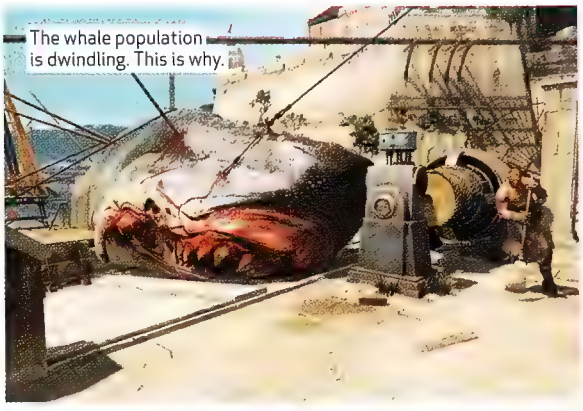
As in *Dishonored*, your targets are people of means. They're protected, and getting to them requires either a lot of sneaking, a lot of stabbing, or a lot of stopping time, possessing the guard who just tried to shoot you, and walking him in front of his own bullet. Emily and Corvo have magical murder powers, granted by the mysterious Outsider.

Abilities have their rules within the world. I played as Emily, whose power set feels tailored for sitting and thinking through the possibilities of your approach. Her best power, Domino, lets you link multiple characters together. What happens to one then happens to them all. Choke out one, and the others fall asleep. Stab one, and the others drop dead. Emily also has a power called Mesmerise, which, when fully upgraded, can hypnotise up to three people, letting you pass by unseen. Another power, Doppelganger, enables Emily to create a clone of herself that distracts guards. It, too, is a physical humanoid entity, and so it, too, can be linked with Domino. That's bad news for any linked guards that catch up to and shoot the clone. While each power has its own, basic use, the implications of the systems create so many possibilities when they're used in combination.

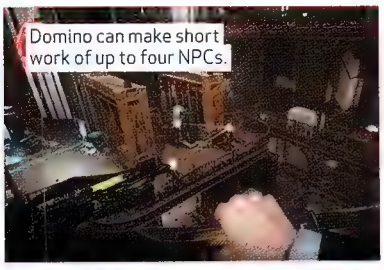
SEE EMILY PLAY

In addition to powers, Emily and Corvo have a multitude of weapons and tools. Many will be familiar to players of *Dishonored*, from the pistol and crossbow, to the spring razor mines that shred any enemy unfortunate enough to get near. The crossbow gets a couple of additional bolt types, and like many of *Dishonored 2*'s changes, they're designed to give more options to non-lethal players. Howling bolts blind and deafen enemies, while stinging bolts cause them to flee in agonising pain. More than ever, *Dishonored 2* realises that stealth and non-lethal options aren't one and the same, and takes steps to provide tools that cater to both methods.

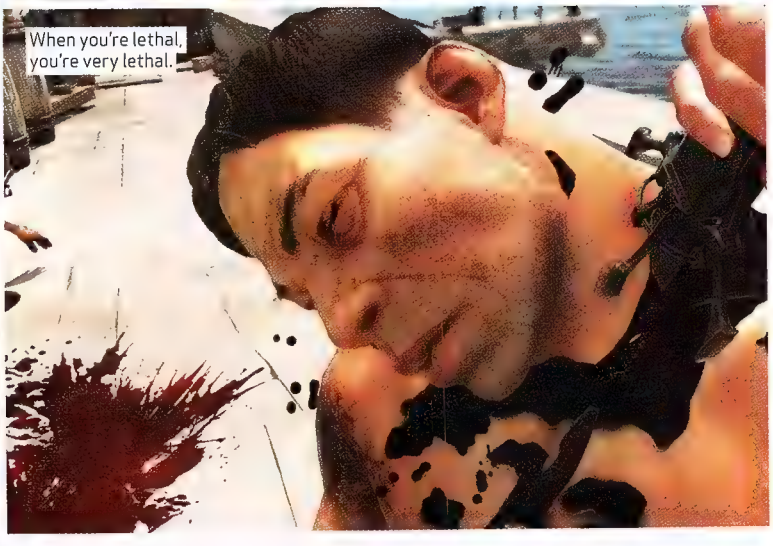
You can kill silently, sneak by undetected, burst into a room and render everyone unconscious, or murder everything in a cacophony of grenades, guns and rat swarms. This is reflected in direct combat, too. Swordplay is no longer a fight to the death. Parry an attack, and you have the option to disable your opponent with a chokehold. It won't work if you're surrounded,


The whale population is dwindling. This is why.

You know it's a good immersive sim when you can peek in rooms.


Domino can make short work of up to four NPCs.

You can combo powers for interesting effects.


When you're lethal, you're very lethal.

but there are other options for that and, once again, they aren't all lethal.

I enjoy stealth, but play stealth games in the most infuriating way possible – quickloading the moment I'm spotted. Here, though, it turns out I like playing non-lethally differently. I'm fine with being spotted, as long as everybody is incapacitated with their head still attached and their miscellaneous viscera intact. In one mission, I was spotted more than 20 times, something I would have balked at in the original *Dishonored*. Here, it was a number that reflected some panicked action sequence, a liberal use of sleep darts and a cool shadow walk power that lets you render a target unconscious with a quick tendril to the head.

If Emily has the more manipulative powerset, Corvo is your man for getting into a fight. Possession is a great, broad stealth ability with applications outside of combat, but Windblast is a boon for crowd control, and Devouring Swarm is a literal, lethal swarm of devouring rats. While Corvo's base powers are the same as those available in the original game, each now has multiple upgrade options. Blink – the short-range teleport that is the bread-and-butter of your traversal options – can be upgraded for a longer distance, but also to knock down enemies if Corvo blinks into them. Far Reach, Emily's parkour tentacle, functions almost identically, except that its upgrade lets you pull enemies towards you, killing or knocking them unconscious in mid-air.

Where Dunwall was a caricature of Victorian London, Karnaca is southern Europe. It's bright and sunny, with attractive buildings sprawling across hills overlooking the glistening water. And yet, while a stark contrast to the grey, drab Dunwall, it's no less dark or grimy. The beauty is a facade. Scratch the surface and you'll find similar squalor and suffering.

That's a premise reflected in the writing, too – one of *Dishonored 2*'s strongest elements. The world is full of notes and diaries, often referring to characters who appear over multiple missions. There's a lot to read, if you want to engage with the deeper stories of this world. And if you don't, there's a lot to loot. Much of my time was spent poking into people's drawers and cupboards looking for things to sell. A black market is available on each level where you can spend this coin, but for me, illicit finance wasn't the main attraction. It's just incredibly satisfying to systematically work through a building's nooks and cupboards, tracking down its valuables.

Even on a higher level, the writing feels more nuanced and subtle than in the original game. Things were rarely black or white in *Dishonored*, but here, the motives often feel more desperate – there's a sense that the inequalities of this world have forced people into a corner.

While Karnaca has an aesthetic theme, each level offers something new – either thematically, visually or, in the best cases, systemically.

LEFT UNSAID

Dishonored 2 is also a story about its protagonists, who are more than just vessels for the player here. In *Dishonored*, Corvo was ultimately a cypher whose personality was expressed through action. That comes across here, too, but Emily is also a character with a proper story arc.

Dishonored 2 is a game I want to celebrate. It's easily as good as its predecessor and frequently better.

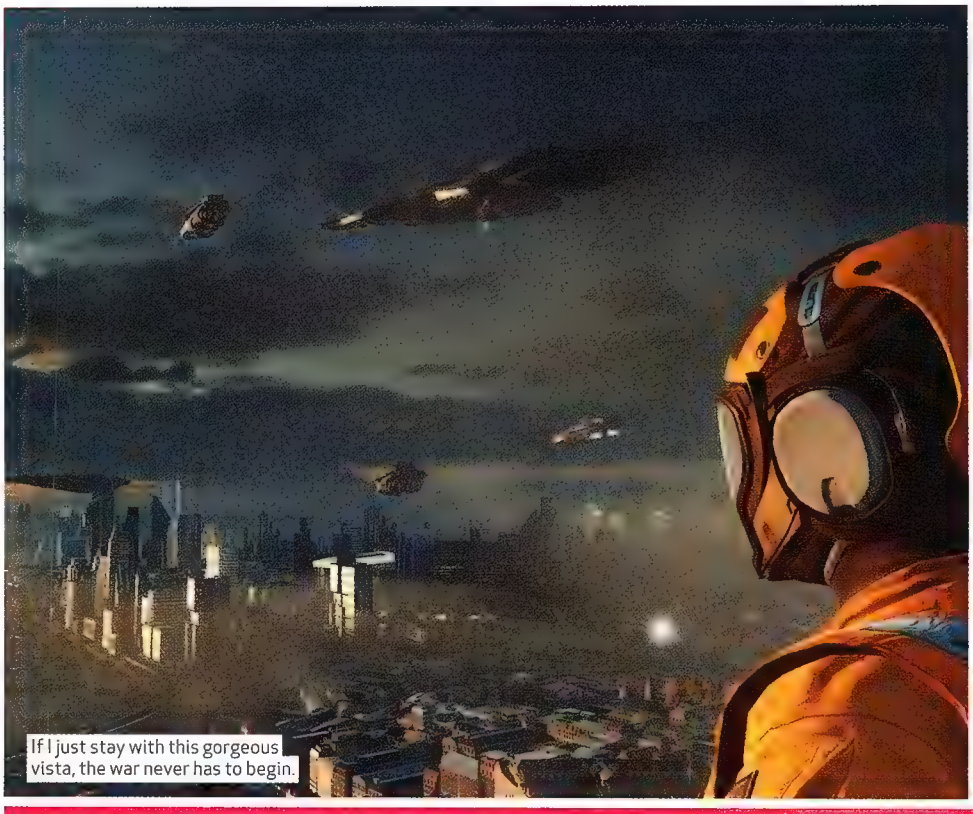
As much as I've delved into the specifics of each individual system, what makes *Dishonored 2* so exceptional is how they're all connected. The writing sheds light on the world, which sheds light on the systems, which sheds light on the environments and characters. For everything that works in isolation, the real trick is that *Dishonored 2* feels unified – a powerful piece of world building where everything happens for a reason.

■ **Phil Savage**

Verdict

A rich, detailed world, tense stealth and frenetic action. *Dishonored 2* is up there with the best immersive sims.

★★★★½


If I just stay with this gorgeous vista, the war never has to begin.

Flying a Jackal is the best part of the game, but even it gets old.

Zombies is fun, but there's only one scenario right now

The little pips from hits are still satisfying.

FROM $89.95 | PC, PS4, XO | WWW.CALLOFDUTY.COM/INFINITEWARFARE

Call of Duty: Infinite Warfare

A stifling single-player campaign and poor multiplayer.

I don't think *Call of Duty* campaigns are supposed to be fun. If I'm reckless at all – like, say, having fun with my jetpack – my vision smears with strawberry jam, blurry and pulsing. My screen shakes, white text yells "Get to cover!" at me and I'm forced to the ground behind hunks of concrete and metal. Then I toss a grenade, which bounces off a squadmate's calf. Friendly fire will not be tolerated, it says. Very little will be tolerated.

There are plenty of cool moments in *Call of Duty: Infinite Warfare*. But when I'm in control during the annual shooter's campaign, I feel weak and ineffective. Many of the enemies can absorb a flurry of bullets (even headshots often just pop their helmets off) and I inflict damage so quickly I have to stay back, run from grenade indicators, pop out of cover and shoot a little bit, then hide again. It's not fun. It's war: chaotic, fearful, deadly. Even with the push deeper into science-fiction, *CoD* hasn't changed much, except in the diminishing size of its multiplayer population.

Infinite Warfare's multiplayer remains the opposite of the campaign in many ways: a zipping cyclone of bullets and bodies. Keep circling, checking the minimap, aiming at corners, crouching and jumping. Move weirdly so you're hard to hit and aim true: only a second separates you from a kill and eating dirt.

The new Frontline mode is my favourite, but not many people are playing it. As I write, I can't get into a match. Team Deathmatch is more populated, but any time I've checked, *Black Ops III* has at least half as many concurrent players as *Infinite Warfare*. Compared to *Overwatch*, *CounterStrike: GO*, *Payday 2* and *Rainbow Six Siege*, *Infinite Warfare* is not a very well populated multiplayer at launch.

It also took me about five minutes to gather a public Zombies match – *CoD*'s staple co-op horde mode – together. There's one scenario to play at the moment, Spaceland, and it's a satisfying *Left 4 Dead*-ish experience, well maintained and campy. But it's the only one.

Even if the campaign isn't much fun and the multiplayer follows the 'more is better' approach of the past nine years, *Infinite Warfare* is a hell of a spectacle. It has some of the coolest scenes I've ever seen in a videogame. Skydiving to Europa. Careening over a crater in a moon buggy, with big blue Earth hanging in the sky, explosions all around. I never tired of watching entire enemy squads get sucked into space when we blasted their windows.

But those bombastic action scenes pair oddly with *Infinite Warfare*'s stifling play. Soldiers can both leap through space with ripped suits and be killed by an exploding car they walked too close to.

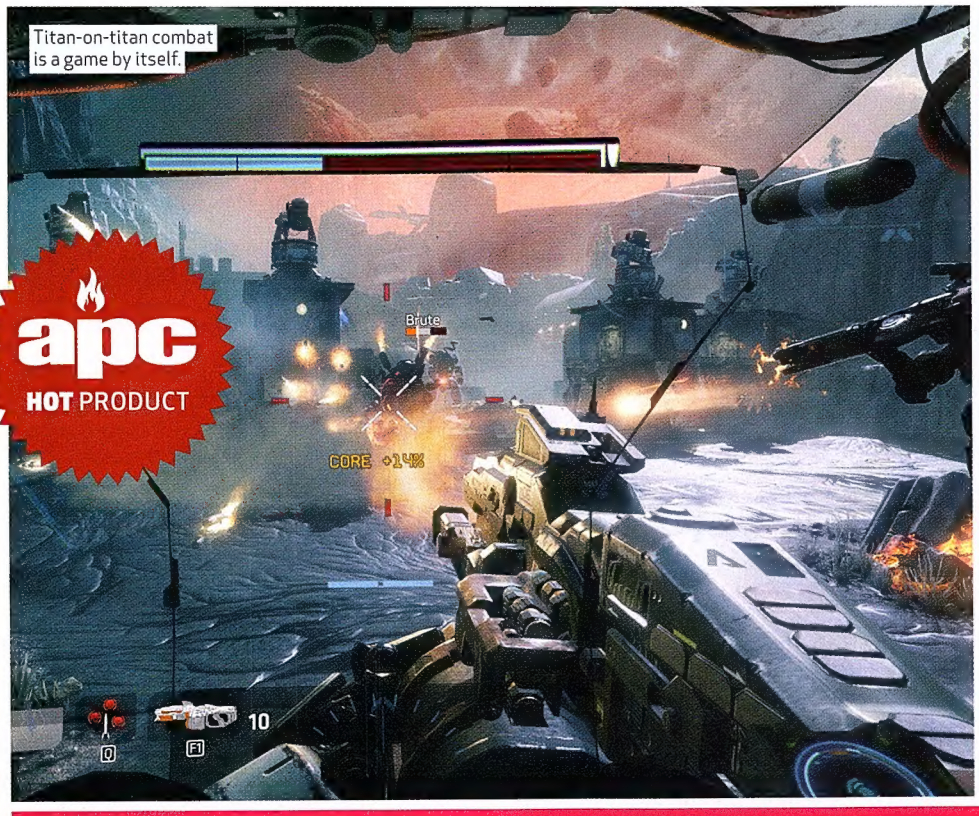
When the big set pieces and bad story are stripped out, it's just a grinding cover war. I don't have a good outlook for *Infinite Warfare*'s longevity on PC and there isn't enough for me to recommend spending money on it.

Tyler Wilde

Verdict

A beautiful action movie that punishes improvisation and has under-populated multiplayer.

★★½



Titan-on-titan combat is a game by itself.

apc HOT PRODUCT

When it wants to be *CoD*, it's very good *CoD*.

There's a little bit of heart in *Titanfall 2*.

It feels great to pull off a titan execution in multiplayer.

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Titanfall 2

Wall-runs up and over the competition.

Titanfall 2's brilliance comes as a surprise, and I say that as somebody who loved the original despite its flaws. In that first attempt, Respawn created a set of traversal, gunplay and mech combat systems served well by their multiplayer framework.

Titanfall 2 is a very different game. There's a lot packed into the 6–7 hours it will take you to finish the campaign, with each section finding its own way to surprise you.

You'll engage in a running firefight through a massive factory that is throwing prefab colony buildings together around you as you go. You'll perform a beach landing alongside a phalanx of allied titans. You'll engage in mech duels against a cast of mercenary titan pilots pulled straight from an 1980s action movie.

If there's anything holding *Titanfall 2* back, it's that not all its chapters are created equal. It has some good ideas, some great ideas and one brilliant idea. However, even during its less-inspired moments, the worst this game gets is 'very good shooter with very big robots'.

Titanfall 2 is built on rock-solid foundations. There are loads of weapons to try, from SMG staples to powerful shotgun pistols to gravity grenades and remote satchel charges. These feel and sound phenomenal. This is coupled with the series' brilliant traversal system of double jumps, wall-runs, slides and powerful melee strikes. Shooting is a form of punctuation in *Titanfall* – it's through movement that you really express yourself, to the point that resorting to boring old running on the ground can feel like failure. You've also got a short-duration cloaking device, gated by a cooldown, that lets you reposition in dangerous situations without needing to stop and hide.

The story is above-average AAA action fare, punching above its weight in terms of spectacle and managing to fit in a few decent jokes amid the battle-talk. The central dynamic between protagonist Jack Cooper and the titan he is unexpectedly bonded with, BT, is perfectly enjoyable. It might not stick with you long after the credits roll, but the strength of the campaign as a whole is enough to make me want to spend more time in this game's world.

If *Titanfall 2*'s campaign surprises with quality, its multiplayer surprises with the amount that has changed. All the same ideas return, from freerunning pilots to titan calldowns to NPC minions and limited-use power spikes, but each has been rethought. It's extremely fast-paced and highly lethal, with grappling hooks, speed boosts and phase-shift abilities raising the skill ceiling of movement. An old-school degree of finesse is possible here, and when you watch from the perspective of a good player, you'll realise just how much skill it's possible to express by carefully chaining abilities together.

This is a game that takes some of the most familiar vocabulary in this hobby – run, jump, shoot, spaceship, robot, alien dog – and finds ways to surprise you with each of them.

When it comes down to it, that's what *Titanfall 2* deserves to be remembered for. ■ **Chris Thursten**

Verdict

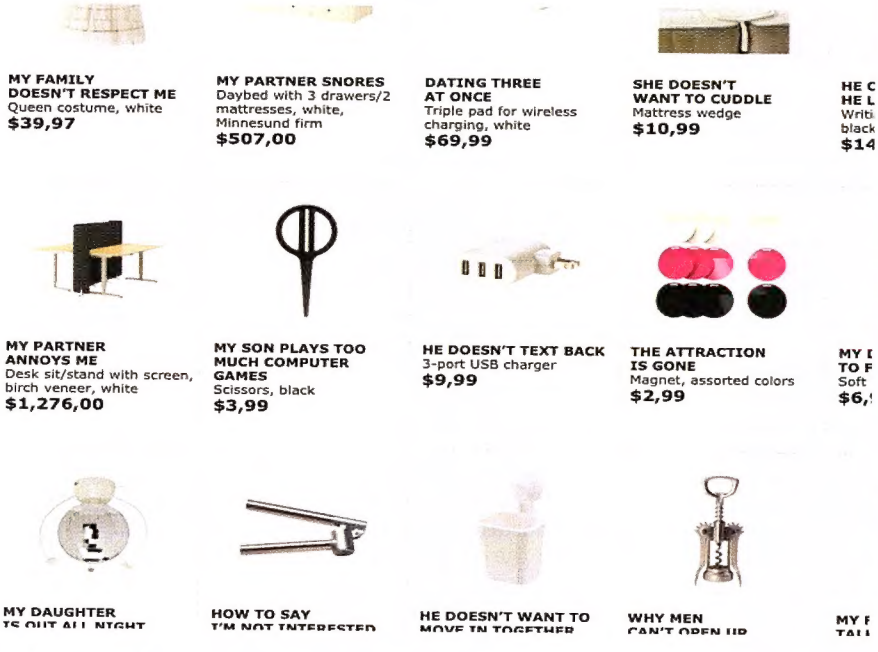
A brilliant singleplayer campaign married to inventive, skill-intensive multiplayer.

★★★★½

Privates staying private

IoT-connected vibrator no longer allowed to monitor usage.

In the December issue (page 114), we brought you the news that the manufacturer of a vibrator connected to the Internet of Things was being sued for collecting sensitive data on customers. Standard Innovation, the company behind the We-Vibe sex toy, has now agreed to settle the lawsuit. It has been alleged that the app chronicled how long customers used the sex toy and tracked vibration and temperature settings, then sent them to the company servers in Canada. Standard Innovation has since apologised for not keeping customers' privates, well, private and are in the process of updating their privacy policy.



Relationship advice from furniture

IKEA NAMES PRODUCTS AFTER POPULAR GOOGLE SEARCHES.

If you've been having trouble pronouncing the furniture names at IKEA, then you might be relieved to know that certain products from the flat-pack giant are now getting English alternatives – from Google's most-searched relationship issues in Sweden. IKEA's latest campaign, called Retail Therapy, advertises products that are paired with a Googled relationship query that can "fix" the issue. For example, How To Make Long Distance Work is a cardboard moving box, and My Boyfriend Doesn't See Me is a lantern for a candle. The company has hit the mark from an SEO perspective, but have also found a way to keep their customers entertained. Neat! Now, where did that Allen key get to?

New ransomware promises free unlock key

BUT ONLY IF YOU'RE A DEGENERATE AND INFECT YOUR FRIENDS...

A new ransomware variant called Popcorn Time – in no way associated with the Popcorn Time torrent client – comes with it's own "referral program". This particularly nasty malware encrypts files on a hard drive, then victims are given the choice of either paying a ransom or selling out their friends. If targets can't afford the one bitcoin ransom (about $1,037), they can be a scumbag and pass on a link to the malware to two friends. If the friends pay up, the original victim receives the decryption key for free. The malware's source code even suggests that, if the decryption key is entered incorrectly four times, the data will be permanently locked. I might need to cull a few friends...

Google changes auto-fill suggestions

AIMS TO REDUCE OFFENSIVE OPTIONS.

Google finally agrees that Jews and women are no longer 'evil' and Muslims are not 'bad'. The company took action after receiving complaints about offensive entries coming up on the search engine's autocomplete feature. The auto-fill suggestions can, or course, be quite useful – saving time or providing giggles when it's completely off the mark. But in defence of the company, a representative said that the search results reflected the content on the internet. Meaning "sometimes unpleasant portrayals of sensitive subject matter online can affect what search results appear for a given query," and the results "don't reflect Google's own opinions or beliefs". ■

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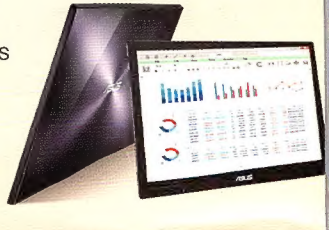

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